

INTERNATIONAL STANDARD

IEC
61937-5

First edition
2002-08

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

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



Reference number
IEC 61937-5:2002(E)

Publication numbering

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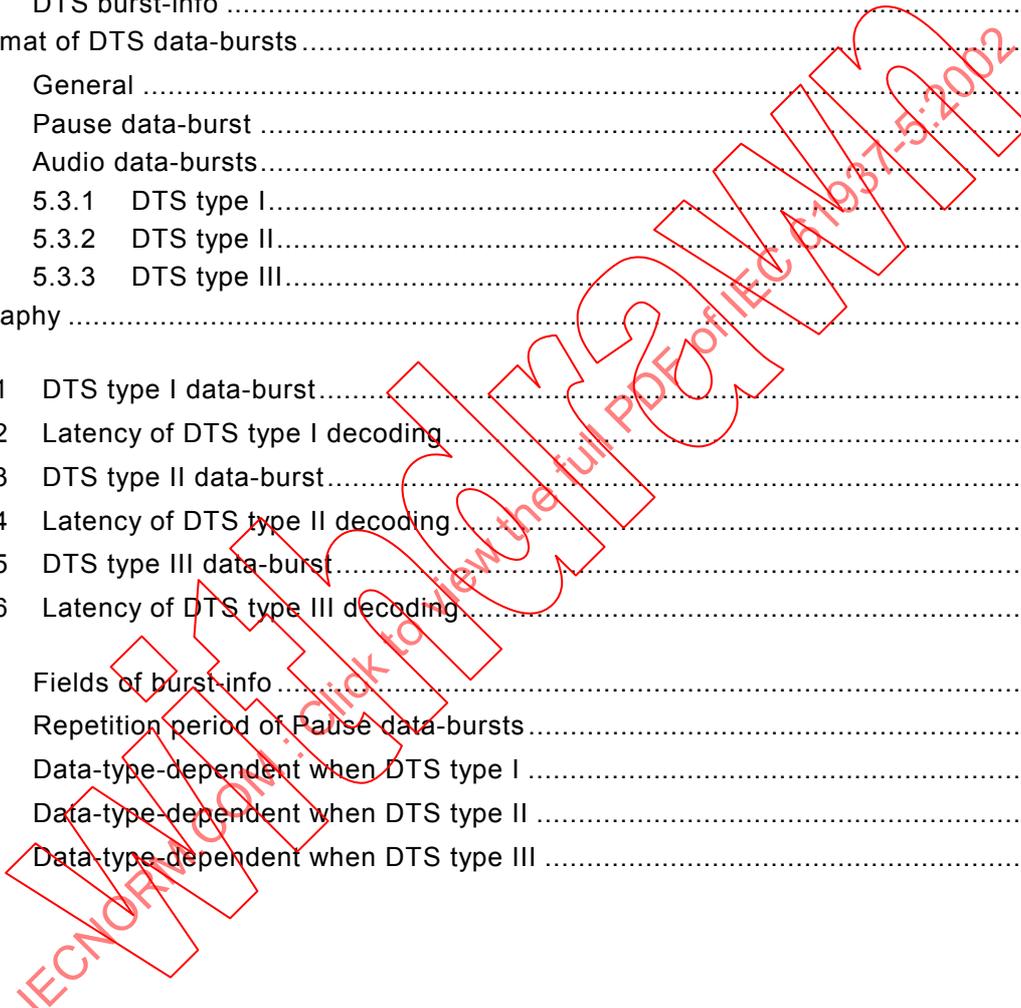
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CONTENTS

FOREWORD	3
1 Scope	4
2 Normative references	4
3 Definitions and abbreviations	4
4 Mapping of the audio bitstream on to IEC 61937-1	5
4.1 DTS burst-info	5
5 Format of DTS data-bursts	5
5.1 General	5
5.2 Pause data-burst	5
5.3 Audio data-bursts	5
5.3.1 DTS type I	5
5.3.2 DTS type II	7
5.3.3 DTS type III	8
Bibliography	10
Figure 1 DTS type I data-burst	6
Figure 2 Latency of DTS type I decoding	7
Figure 3 DTS type II data-burst	7
Figure 4 Latency of DTS type II decoding	8
Figure 5 DTS type III data-burst	8
Figure 6 Latency of DTS type III decoding	9
Table 1 Fields of burst-info	5
Table 2 Repetition period of Pause data-bursts	5
Table 3 Data-type-dependent when DTS type I	6
Table 4 Data-type-dependent when DTS type II	7
Table 5 Data-type-dependent when DTS type III	9



INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

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

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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This part of International Standard IEC 61937 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
100/499/FDIS	100/538/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.

The committee has decided that this publication remains valid until 2005. At this date, in accordance with the committee's decision, 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 5: Non-linear PCM bitstreams according to the DTS (Digital Theater Systems) format (s)

1 Scope

This part of IEC 61937 describes audio bitstreams encoded according to the Digital Theater Systems (DTS) format data-types I, II and III.

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 60958-1:1999, *Digital audio interface – Part 1: General*

IEC 60958-3:1999, *Digital audio interface – Part 3: Consumer applications*

IEC 60958-4:1999, *Digital audio interface – Part 4: Professional applications*

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

IEC 61937-2, *Digital audio – Interface for non-linear PCM encoded audio bitstreams applying IEC 60958 – Part 2: Burst information*¹

3 Definitions and abbreviations

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

3.1 Definition

latency

delay time of an external audio decoder to decode a DTS data-burst, defined as the sum of two values of the receiving delay time and the decoding delay time

3.2 Abbreviations

DTS Digital Theater Systems

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

3.3 Presentation convention

F872h

Value 'F872' in hexadecimal format

¹ To be published.

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

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

4.1 DTS burst-info

The 16-bit burst-info contains information about the data which will be found in the data-burst.

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 – 10	In accordance with IEC 61937-2		
	11	DTS type I	bit 0 of Pa	512
	12	DTS type II	bit 0 of Pa	1 024
	13	DTS type III	bit 0 of Pa	2 048
	14 – 31	In accordance with IEC 61937-2		
5 – 15		In accordance with IEC 61937-2		

5 Format of DTS data-bursts

This clause specifies the audio data-bursts DTS type I, DTS type II and DTS type III. Specific properties such as reference points, repetition period, the method of filling stream gaps, and decoding latency are specified for each data-type.

5.1 General

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 DTS type I, DTS type II, DTS type III 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
DTS type I	-	3 IEC 60958 frames
DTS type II	-	3 IEC 60958 frames
DTS type III	-	3 IEC 60958 frames

5.3 Audio data-bursts

5.3.1 DTS type I

The DTS consists of sequences of DTS frames. The data-type of a DTS data-burst type I is 0Bh. The data-burst is headed with a burst-preamble, followed by the burst-payload, and

stuffed with stuffing bits. The burst-payload of each data-burst of DTS type I data shall contain one complete DTS-frame, and represents 512 samples for each encoded channel.

NOTE 1 The length of the DTS type I data-burst depends on the encoded bit rate (which determines the DTS-frame length).

NOTE 2 The reference to the specification for the DTS bitstream, representing 512 samples of encoded audio per frame, is given in the bibliography.

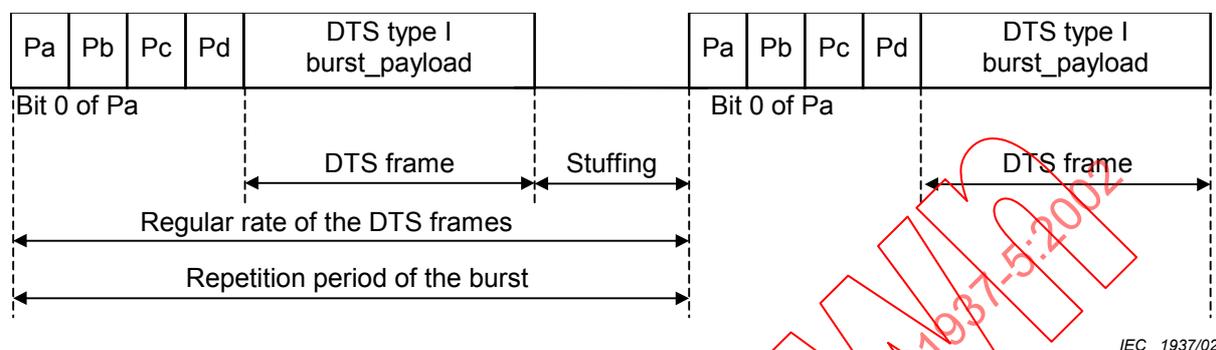


Figure 1 – DTS type I data-burst

The data-type-dependent information for DTS type I is given in Table 3.

Table 3 – Data-type-dependent when DTS type I

Bits of Pc LSB..MSB	Value	Contents
8 – 12	00h	Reserved, shall be set to '0'

The reference point of a DTS type I data-burst is bit 0 of Pa and occurs exactly once every 512 sampling periods. The data-burst containing DTS type I frames occurs at a regular rate, with the reference point of each DTS type I data-burst beginning 512 IEC 60958 frames after the reference point of the preceding DTS type I data-burst (of the same bit-stream-number).

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

When a stream gap in a DTS type I stream is filled by a sequence of Pause data-bursts, the Pa of the first Pause data-burst shall be located 512 sampling periods following the Pa of the previous DTS type I 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 DTS type I data-burst which follows the stream gap.

NOTE 3 The gap-length parameter contained in the Pause data-burst is intended to be interpreted by the DTS decoder as an indication of the number of decoded PCM samples which are missing (due to the resulting audio gap).

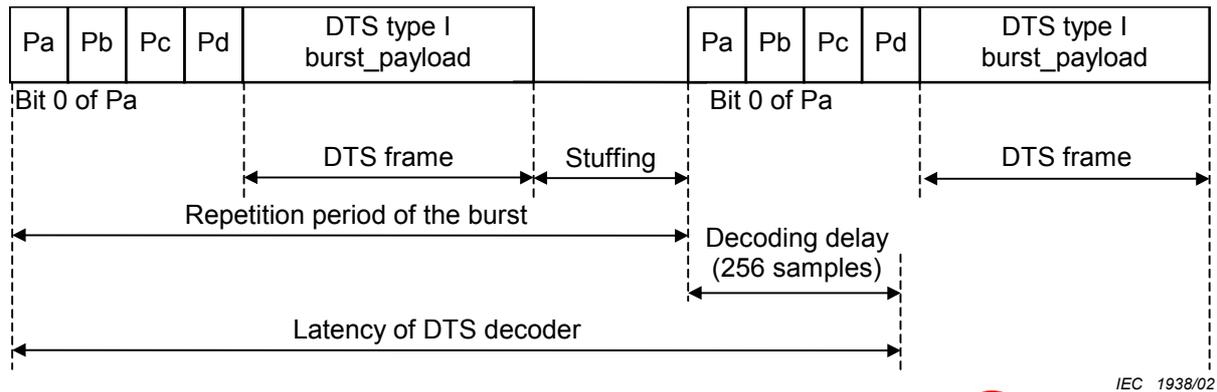


Figure 2 – Latency of DTS type I decoding

NOTE 4 The latency of a DTS decoder is defined as a delay measured from the reference point, and equal to one frame (10,67 ms) plus 5,33 ms (equivalent to 256 samples). This is 768 PCM samples or 16 ms at 48 kHz sampling frequency.

5.3.2 DTS type II

The DTS consists of sequences of DTS frames. The data-type of a DTS data-burst type II is 0Ch. The data-burst is headed with a burst-preamble, followed by the burst-payload, and stuffed with stuffing bits. The burst-payload of each data-burst of DTS type II data shall contain one complete DTS-frame and represents 1 024 samples for each encoded channel.

NOTE 1 The length of the DTS type II data-burst depends on the encoded bit rate (which determines the DTS-frame length).

NOTE 2 The reference to the specification for the DTS bitstream, representing 1 024 samples of encoded audio per frame, is given in the bibliography.

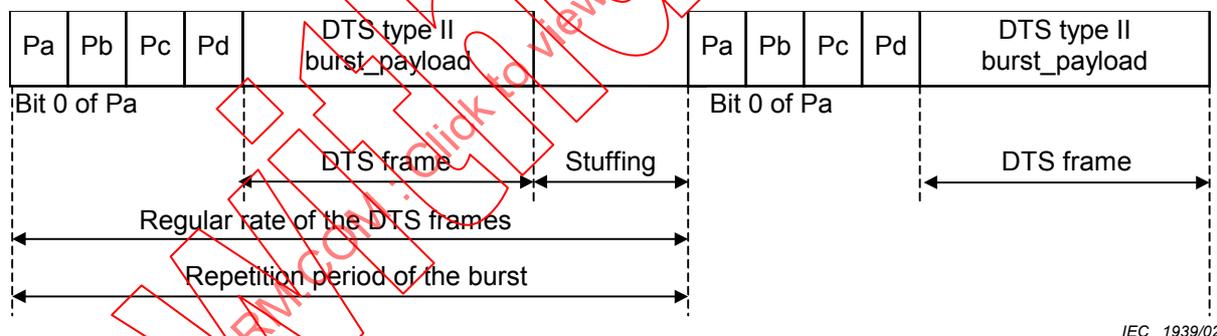


Figure 3 – DTS type II data-burst

The data-type-dependent information for DTS type II is given in Table 4.

Table 4 – Data-type-dependent when DTS type II

Bits of Pc LSB..MSB	Value	Contents
8 – 12	00h	Reserved, shall be set to '0'

The reference point of a DTS type II data-burst is bit 0 of Pa and occurs exactly once every 1 024 sampling periods. The data-burst containing DTS type II frames shall occur at a regular rate, with the reference point of each DTS type II data-burst beginning 1 024 IEC 60958 frames after the reference point of the preceding DTS type II data-burst (of the same bit-stream-number).

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

When a stream gap in a DTS type II stream is filled by a sequence of Pause data-bursts, the Pa of the first Pause data-burst shall be located 1 024 sampling periods following the Pa of the previous DTS type II 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 DTS type II data-burst which follows the stream gap.

NOTE 3 The gap-length parameter contained in the Pause data-burst is intended to be interpreted by the DTS decoder as an indication of the number of decoded PCM samples which are missing (due to the resulting audio gap).

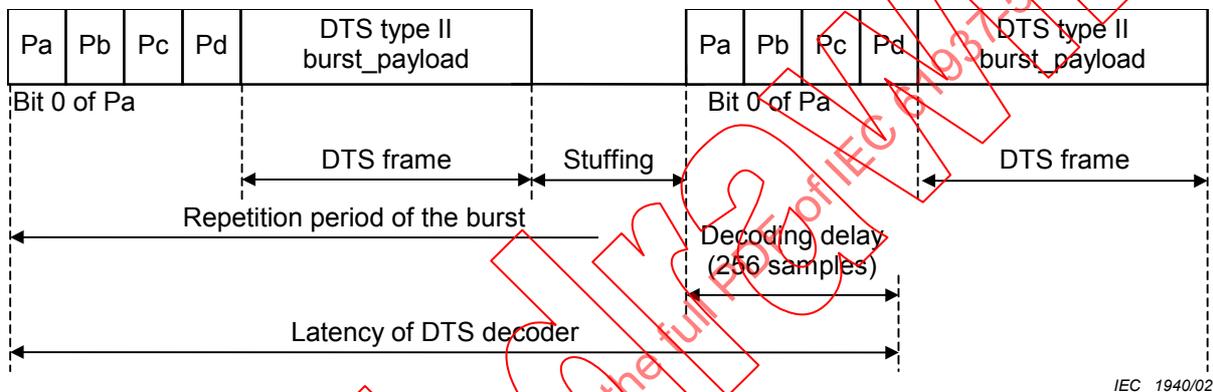


Figure 4 – Latency of DTS type II decoding

NOTE 4 The latency of a DTS decoder is defined as a delay measured from the reference point, and equal to one frame (21,34 ms) plus 5,33 ms (equivalent to 256 samples). This is 1 280 PCM samples or 26,67 ms at 48 kHz sampling frequency.

5.3.3 DTS type III

The DTS consists of sequences of DTS frames. The data-type of a DTS data-burst type III is 0Dh. The data-burst is headed with a burst-preamble, followed by the burst-payload, and stuffed with stuffing bits. The burst-payload of each data-burst of DTS type III data shall contain one complete DTS-frame and represents 2 048 samples for each encoded channel.

NOTE 1 The length of the DTS type III data-burst depends on the encoded bit rate (which determines the DTS-frame length).

NOTE 2 The reference to the specification for the DTS bitstream, representing 2 048 samples of encoded Audio per frame, is given in the bibliography.

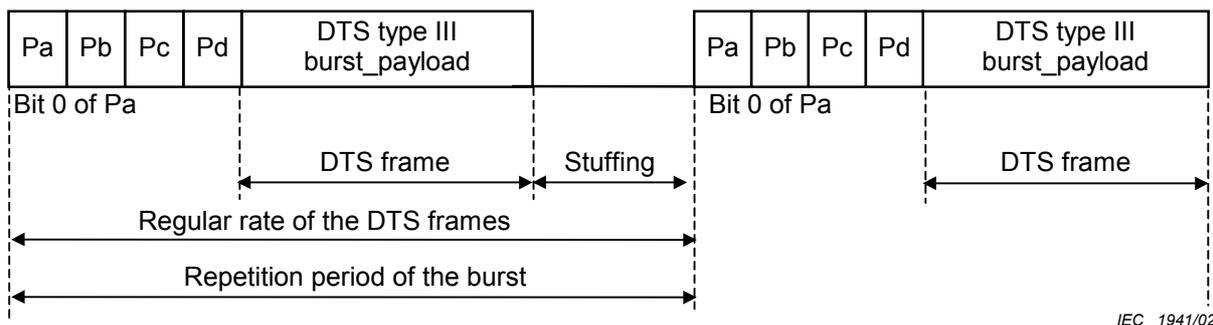


Figure 5 – DTS type III data-burst

The data-type-dependent information for DTS type III is given in Table 5.

Table 5 – Data-type-dependent when DTS type III

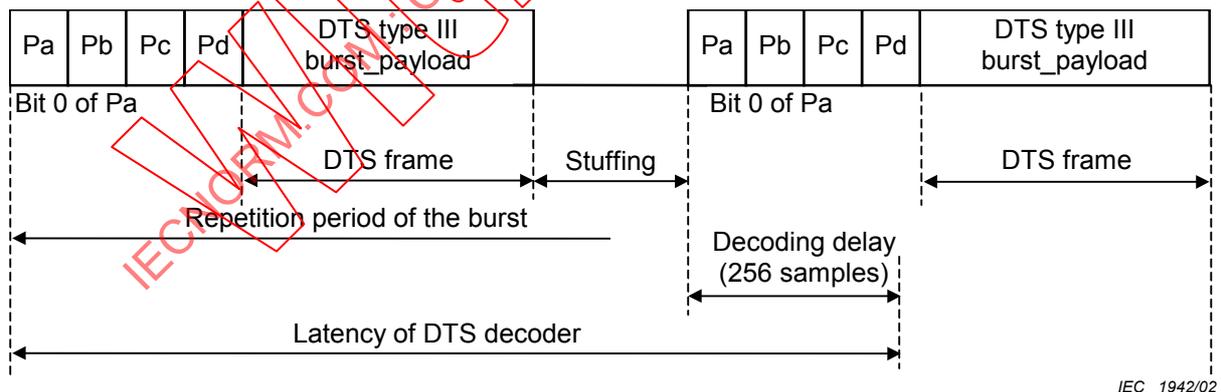
Bits of Pc LSB..MSB	Value	Contents
8 – 12	00h	Reserved, shall be set to '0'

The reference point of a DTS type III data-burst is bit 0 of Pa and occurs exactly once every 2 048 sampling periods. The data-burst containing DTS type III frames shall occur at a regular rate, with the reference point of each DTS type III data-burst beginning 2 048 IEC 60958 frames after the reference point of the preceding DTS type III data-burst (of the same bit-stream-number).

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

When a stream gap in a DTS type III stream is filled by a sequence of Pause data-bursts, the Pa of the first Pause data-burst shall be located 2 048 sampling periods following the Pa of the previous DTS type III 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 DTS type III data-burst which follows the stream gap.

NOTE 3 The gap-length parameter contained in the Pause data-burst is intended to be interpreted by the DTS decoder as an indication of the number of decoded PCM samples which are missing (due to the resulting audio gap).



IEC 1942/02

Figure 6 – Latency of DTS type III decoding

NOTE 4 The latency of a DTS decoder is defined as a delay measured from the reference point, and equal to one frame (42,67 ms) plus 5,33 ms (equivalent to 256 samples). This is 2 304 PCM samples or 48 ms at 48 kHz sampling frequency.

Bibliography

The following document has served as a reference for the specification of the related data-type.

DTS *DTS Coherent Acoustics Decoder*, Ver 1.0, 1997 ¹

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¹ *DTS Coherent Acoustic Decoder* is a document of Digital Theater Systems, Inc. 5171 Clareton Drive, Agoura Hills, CA 91301