# INTERNATIONAL STANDARD

# IEC 62447-3

First edition
2007-06

## Helical-scan compressed digital video cassette system using 6,35 mm magnetic tape – Format D-12 –

## Part 3: Data stream format



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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

# HELICAL-SCAN COMPRESSED DIGITAL VIDEO CASSETTE SYSTEM USING 6,35 mm MAGNETIC TAPE – FORMAT D-12 –

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International Standard IEC 62447-3 has been prepared by IEC technical committee 100: Audio, video and multimedia systems and equipment.

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

| CDV | Report on voting |
|---|---|
| 100/1093/CDV | 100/1188/RVC |

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 list of all the parts of the IEC 62447 series, under the general title *Helical-scan compressed digital video cassette system using 6,35 mm magnetic tape – Format D-12* can be found on the IEC website.

This part 3 describes the specifications for transmission of DV-based compressed video and audio data stream over 270 Mb/s and 360 Mb/s serial digital interface.

Part 1 describes the VTR specifications which are tape, magnetization, helical recording, modulation method and basic system data for video compressed data.

Part 2 describes the specifications for encoding process and data format for 1080i, 1080p and 720p systems.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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

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- withdrawn;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

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

# HELICAL-SCAN COMPRESSED DIGITAL VIDEO CASSETTE SYSTEM USING 6,35 mm MAGNETIC TAPE – FORMAT D-12 –

## Part 3: Data stream format

## 1 Scope

This part of IEC 62447defines the format of the data stream for the synchronous exchange of DV-based audio, data, and compressed video (whose data structure is defined in SMPTE 370M) over the interface defined in SMPTE 305M. It covers the transmission of audio, subcode data and compressed video packets associated with DV-based 100 Mb/s data structures for 525/60 SDTI and 625/50 SDTI systems.

Space within SMPTE 305M not used by a data stream conforming to this standard may be used for the transmission of data other than those representing DV-based audio, data and compressed video.

In this standard, the 60 Hz system refers to the field-frequency 59,94 Hz system and the 50 Hz system refers to the field-frequency 50,0 Hz system.

## 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.

SMPTE 305M.2-2000, Television – Serial Data Transport Interface

## 3 Abbreviations and acronyms

| | |
|---|---|
| SDI | Serial digital interface |
| SDTI | Serial data transport interface |
| ECC | Error correction code |
| DIF | Digital interface |
| ST | Signal type |
| STVF | Signal type of video frame |
| FF | Field/frame frequency flag |
| DVF | DIF valid flag |
| FSNF | Frame sequence number flag |
| TRF | Transmission rate flag |
| TT | Transmission type |

# 4 Identification within the serial data transport interface (SDTI)

## 4.1 SDTI header packet data

The header packet data words of the serial data transport interface (SDTI) associated with this data stream format shall conform to SMPTE 305M. When the SDTI interface transports a data stream conforming to this standard, the block type word within the SDTI header packet shall have the value $173_h$ for transported data contained in fixed-size blocks when ECC is used and the value $233_h$ when ECC is not used.

## 4.2 Payload

The payload is composed of consecutive fixed-size blocks (see Figure 1). The SDTI data type word shall identify the data type of this payload with the value $221_h$.

# 5 Stream block format

## 5.1 Stream block

The stream block format is shown in Figure 1. The length of each stream block is 170 words, including a secondary header, two DIF (digital interface) block IDs, two DIF block data (of stream data) and an ECC block. The secondary header contains reserved data words, signal type words, and a transmission type word. The complete word structure of the stream block for a compressed video data stream is defined below.

| | |
|---|---|
| Reserved data | : 3 words |
| Signal type | : 2 words |
| Transmission type | : 1 word |
| DIF block ID | : 3 words |
| DIF block data | : 77 words |
| DIF block ID | : 3 words |
| DIF block data | : 77 words |
| ECC | : 4 words |

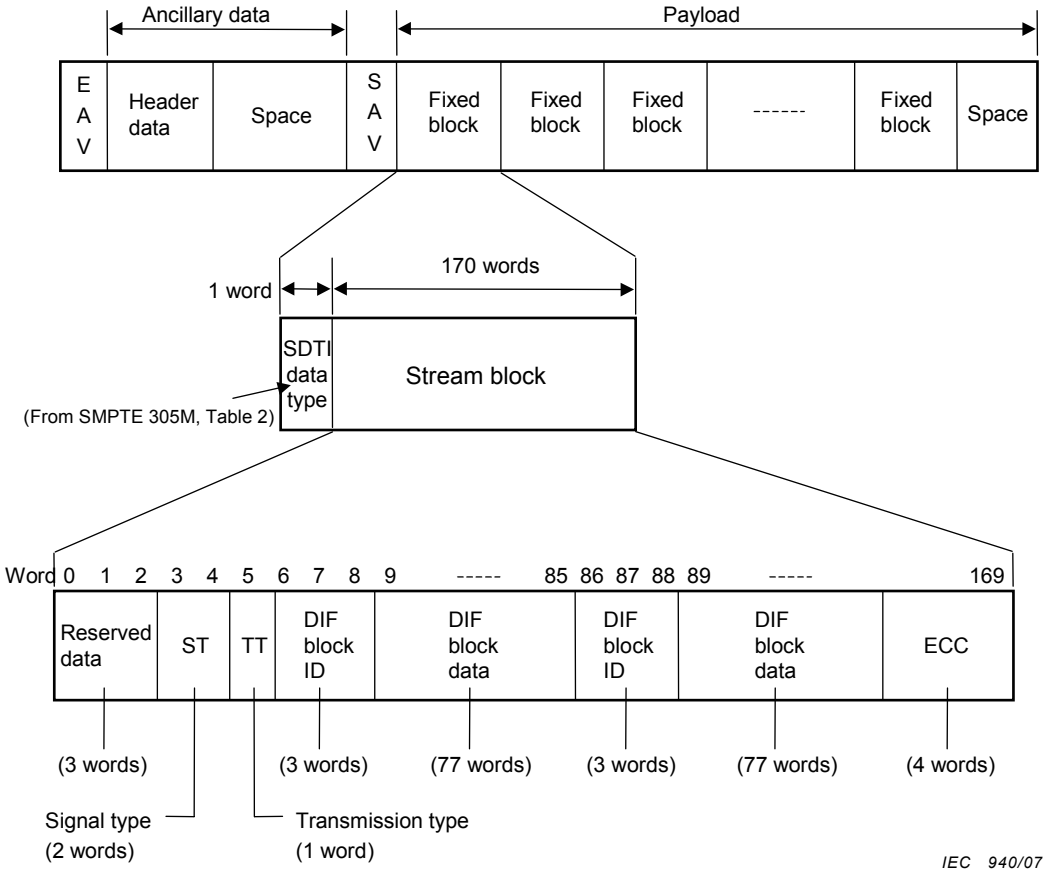


**Figure 1 – Stream block format**

## 5.2 Reserved data words

The reserved data words shall consist of 3 words and be positioned at the start of the stream block. The default value for the reserved data is $200_h$.

## 5.3 Signal type words

The signal type word (ST) mapping is shown in Figure 2. The signal type words shall consist of two words. The first word of ST (word 3) includes the specific type of video frame ID (STVF ID). The second word of ST (word 4) includes the field/frame frequency flag (FF), the DIF structure format, the DIF valid flag (DVF), the frame sequence number flag (FSNF), the transmission rate flag (TRF) and reserved bits.

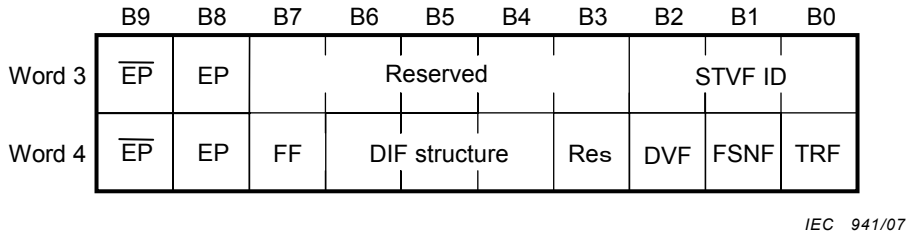


**Figure 2 – ST word mapping**

a) Word 3 of ST

The STVF ID shows information mainly related to pictures that have been 3:2 pull-down converted from 480 line/29,98 frame rate progressive pictures.

All values of bits B7 through B0 are set to $00_h$ as default values.

Bit B8 of word 3 is equal to the even parity of B7 through B0.

Bit B9 of word 3 is equal to the complement of B8.

b) Word 4 of ST

Bit B7 indicates the field frequency of SDI with the following values:

B7

0 : 60 Hz (59,94 Hz)
1 : 50 Hz

Bits B6 through B4 indicate the DIF structure with the following values:

| B6 | B5 | B4 | |
|---|---|---|---|
| 0 | 0 | 0 | : Reserved |
| 0 | 0 | 1 | : Reserved |
| 0 | 1 | 0 | : Reserved |
| 0 | 1 | 1 | : 25 Mb/s structure |
| 1 | 0 | 0 | : Reserved |
| 1 | 0 | 1 | : 50 Mb/s structure |
| 1 | 1 | 0 | : 100 Mb/s structure |
| 1 | 1 | 1 | : Reserved |

Bit B3 is reserved bit and shall be set to $0_b$ as default value.

Bit B2 is the DVF and indicates the validity of the DIF data mapped into SDTI.

B2
0 : Invalid
1 : Valid

Bit B1 is the FSNF and indicates the validity of the frame sequence number (see 4.3) with the following values:

B1
0 : Valid
1 : Invalid

Bit B0 is the TRF and indicates the validity of the transmission rate (see 4.3) with the following values:

B0
0 : Valid
1 : Invalid

Bit B8 is equal to the even parity of B7 through B0.

Bit B9 is equal to the complement of B8.

### 5.4 Transmission type word

The TT word mapping is shown in Figure 3. The TT word shall consist of one word including the frame sequence number and the transmission rate.

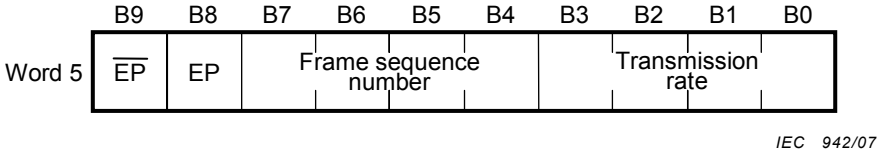


**Figure 3 – TT word mapping**

Bits B7 through B4 indicate the frame sequence number with the following values:

$0_h$ : 1
$1_h$ : 2
|
$F_h$ : 16

The frame sequence number identifies frames multiplexed within an SDTI frame.

Bits B3 through B0 indicate the transmission rate with the following values:

$0_h$ : 1 x (normal transmission rate) (see note)
$1_h$ : 2 x
$2_h$ : 3 x
$3_h$ : 4 x
$4_h$ : 5 x
$5_h$ : 6 x
$6_h$ : 7 x
$7_h$ : 8 x
$8_h$ – $E_h$: Reserved
$F_h$ : 16 x

NOTE The multiple of the normal transmission rate is represented by x. The normal transmission rate corresponding to normal reproduction of the television picture is 1 x.

Bit B8 is equal to the even parity of B7 through B0.

Bit B9 is equal to the complement of B8.

### 5.5 DIF block ID words

The DIF block ID (ID0-2) shall consist of three words, contained in bits A23 through A0 as shown in Figure 4. The lower 8-bit portion of these three words is specified in SMPTE 370M.

| | B9 | B8 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Word 6 and 86 | $\overline{EP1}$ | EP1 | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 |
| Word 7 and 87 | $\overline{EP2}$ | EP2 | A15 | A14 | A13 | A12 | A11 | A10 | A9 | A8 |
| Word 8 and 88 | $\overline{EP3}$ | EP3 | A23 | A22 | A21 | A20 | A19 | A18 | A17 | A16 |

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**Figure 4 – Mapping of DIF block ID**

EP1 is equal to the even parity of bits A7 through A0;

EP2 is equal to the even parity of bits A15 through A8;

EP3 is equal to the even parity of bits A23 through A16;

and

$\overline{EP1}$ is equal to the complement of EP1;

$\overline{EP2}$ is equal to the complement of EP2;

$\overline{EP3}$ is equal to the complement of EP3.

### 5.6 DIF block data words

The DIF block data shall consist of 77 words. The lower 8 bits of each DIF block word represent the DIF block data, as specified in SMPTE 370M; the higher 2 bits are parity data.

Bits B7 through B0 are DIF block data; Bit B8 is equal to the even parity of B7 through B0;

Bit B9 is equal to the complement of B8.

### 5.7 ECC words

Bits B7 through B0 of the words within a stream block (including reserved data words, the ST word, the TT word and all words of the DIF block ID and DIF block data) are optionally protected by an ECC. The ECC shall consist of four words and be inserted at the end of the stream block.

The ECC is a (170,166) Reed-Solomon code in GF(256), whose field generator polynomial is shown as:

$$P(x) = X^8 + X^4 + X^3 + X^2 + 1$$

where $X^i$ are place-keeping variables in GF(2), the binary field.

The generator polynomial of the code in GF(256) is:

$$G(x) = (x+\alpha)(x+\alpha^2)(x+\alpha^3)(x+\alpha^4)$$

where $\alpha$ is given by $2_h$ in GF(256).

When the value of the block type in the SDTI header (see 4.1) is $173_h$, the Reed-Solomon code shall be contained in C31 through C0 as shown in Figure 5. When the value of the block type is $233_h$, the ECC shall have the fixed value $200_h$.

| | B9 | B8 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Word 166 | $\overline{EP1}$ | EP1 | C7 | C6 | C5 | C4 | C3 | C2 | C1 | C0 |
| Word 167 | $\overline{EP2}$ | EP2 | C15 | C14 | C13 | C12 | C11 | C10 | C9 | C8 |
| Word 168 | $\overline{EP3}$ | EP3 | C23 | C22 | C21 | C20 | C19 | C18 | C17 | C16 |
| Word 169 | $\overline{EP4}$ | EP4 | C31 | C30 | C29 | C28 | C27 | C26 | C25 | C24 |

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**Figure 5 – Mapping of ECC**

EP1 is equal to the even parity of bits C7 through C0;

EP2 is equal to the even parity of bits C15 through C8;

EP3 is equal to the even parity of bits C23 through C16;

EP4 is equal to the even parity of bits C31 through C24;

and

$\overline{EP1}$ is equal to the complement of EP1;

$\overline{EP2}$ is equal to the complement of EP2;

$\overline{EP3}$ is equal to the complement of EP3;

$\overline{EP4}$ is equal to the complement of EP4.

## 6 Transmission order

The transmission order within one frame for 100 Mb/s DV-based compression structures consisting of DIF blocks is shown in Figures 6 and 7.

One frame is carried in four channels, which are transmitted in sequence from the first channel to the fourth channel one after another.

Each channel consists of 10 DIF sequences in the 60 Hz system or 12 DIF sequences in the 50 Hz system. DIF sequences within a frame are transmitted in a DIF sequence order from 0 to n-1. Each DIF sequence is composed of 150 DIF blocks. DIF blocks within a DIF sequence are transmitted sequentially from DIF block 0 to 149.

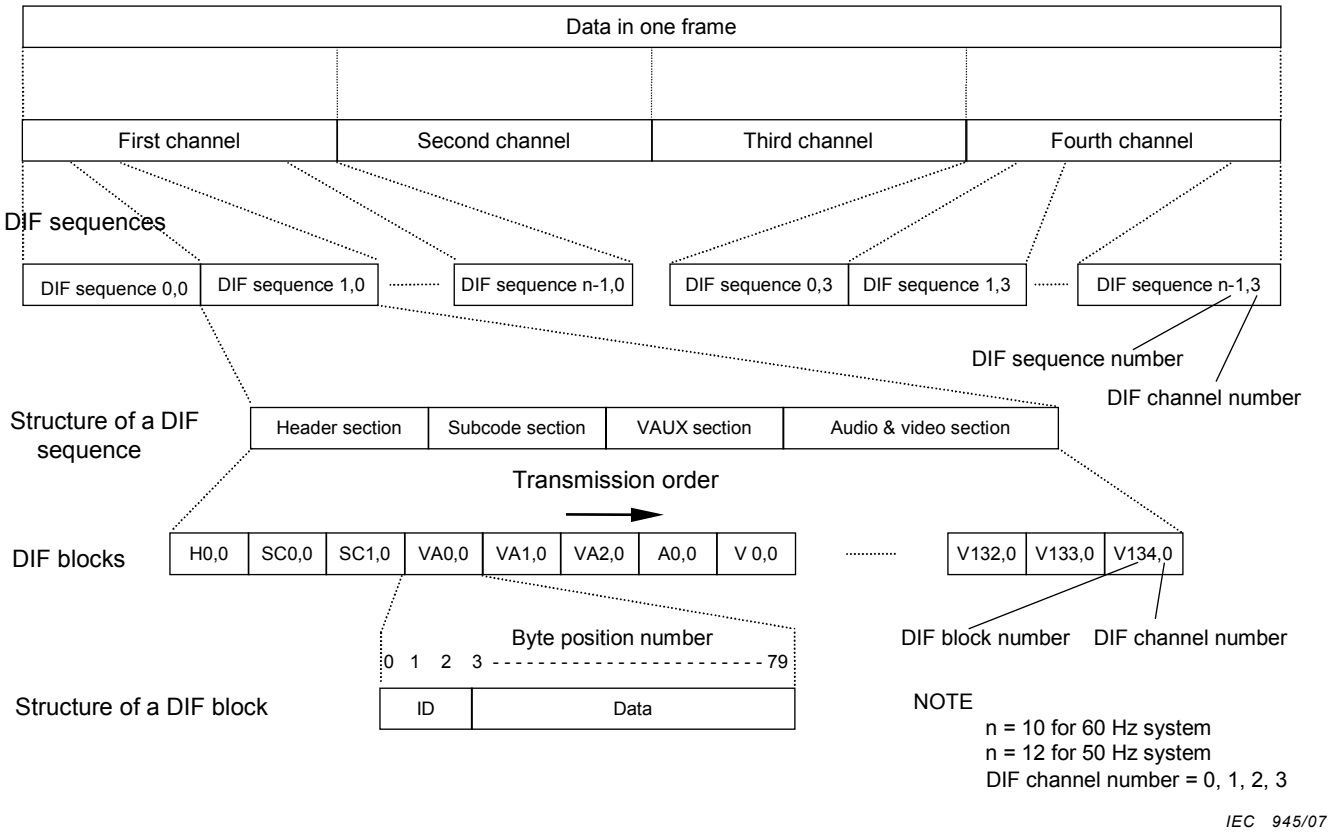
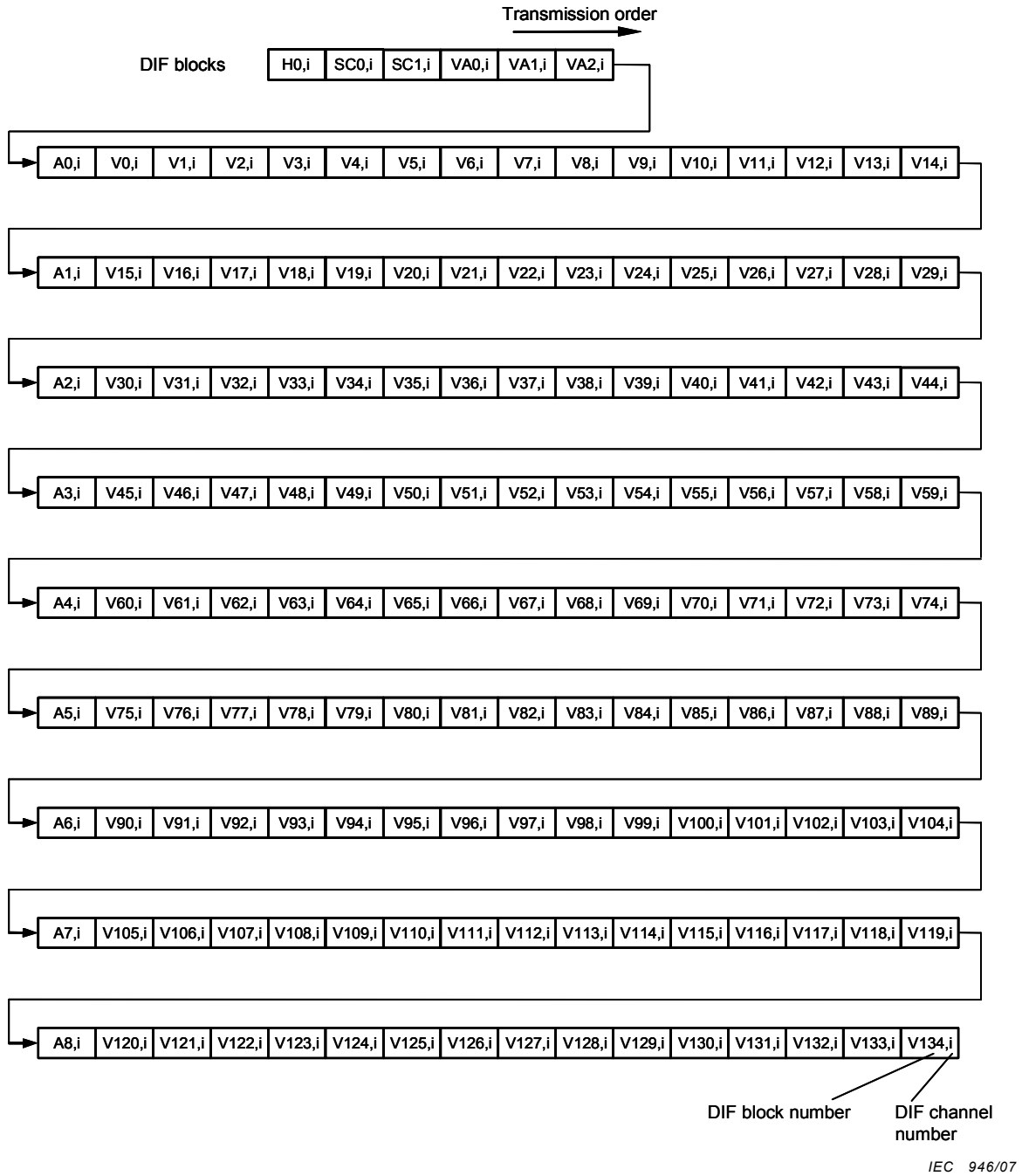



**Figure 6 – Transmission order in one frame for the 100 Mb/s structure**




where

DIF channel number : i = 0,1,2,3 for 100 Mb/s structure;

H0,i : DIF block in header section;

SC0,i to SC1,i : DIF blocks in subcode section;

VA0,i to VA2,i : DIF blocks in VAUX section;

A0,i to A8,i : DIF blocks in audio section;

V0,i to V134,i : DIF blocks in video section.

NOTE The DIF channel number is defined by FSC and FSP as described in SMPTE 370M, Table 5.

**Figure 7 – Transmission order in a DIF sequence**

# 7 Mapping structure

The mapping structure defines where SDTI stream blocks are mapped into SDTI frames.

An SDTI data block of the fixed-block variety (as used by this standard) is based on one stream block; the stream block in turn includes two DIF blocks and associated words, as shown in Figure 1.

In the 525/60 SDTI system, the compressed video data stream within an SDTI frame is composed of 3000 SDTI data blocks (6000 DIF blocks) for the 100 Mb/s structure.

In the 625/50 SDTI system, the compressed video data stream within an SDTI frame is composed of 3600 SDTI data blocks (7200 DIF blocks) for the 100 Mb/s structure.

## 7.1 Channel unit

The channel unit structure is shown in Figures 10 and 11. A channel unit is a series of SDI raster lines into which SDTI data blocks are mapped. In the case of 25 Mb/s structure transmission, a channel unit is composed of the SDTI data blocks of one frame (see 6.2 for the 100 Mb/s structure).

A channel unit is thus composed of 750 SDTI data blocks for the 525/60 SDTI system or 900 SDTI data blocks for the 625/50 SDTI system.

In the 525/60 SDTI system, a channel unit occupies 94 lines in the 270 Mb/s interface or 69 lines in the 360 Mb/s interface; in the 625/50 SDTI system, a channel unit occupies 113 lines in the 270 Mb/s interface or 82 lines in the 360 Mb/s interface.

The remaining payload space within a channel unit should be filled with blocks with their value set to the invalid type number $100_h$, as defined in SMPTE 305M.

## 7.2 Mapping rules

The mapping rules are as follows.

– Channel units consist of contiguous lines with no gaps and shall not use lines 10, 11, 273, or 274 in the 525/60 SDTI system, or lines 6, 7, 319, or 320 in the 625/50 SDTI system.

– The start lines in which a channel unit can be mapped are shown in Table 1.

– A channel unit shall be completely contained within an SDI video field.

One frame shall use four adjacent channel units as shown in Figures 8 and 9. The first part of one frame shall use the first channel unit, the second part of the frame shall use the second channel unit, the third part of the frame shall use the third channel unit and the fourth part of the frame shall use the fourth channel unit.

In the 525/60 SDTI system, 3000 SDTI data blocks are mapped into 376 lines for the 270 Mb/s interface or into 276 lines for the 360 Mb/s interface.

In the 625/50 SDTI system, 3600 SDTI data blocks are mapped into 452 lines for the 270 Mb/s interface or into 328 lines for the 360 Mb/s interface.

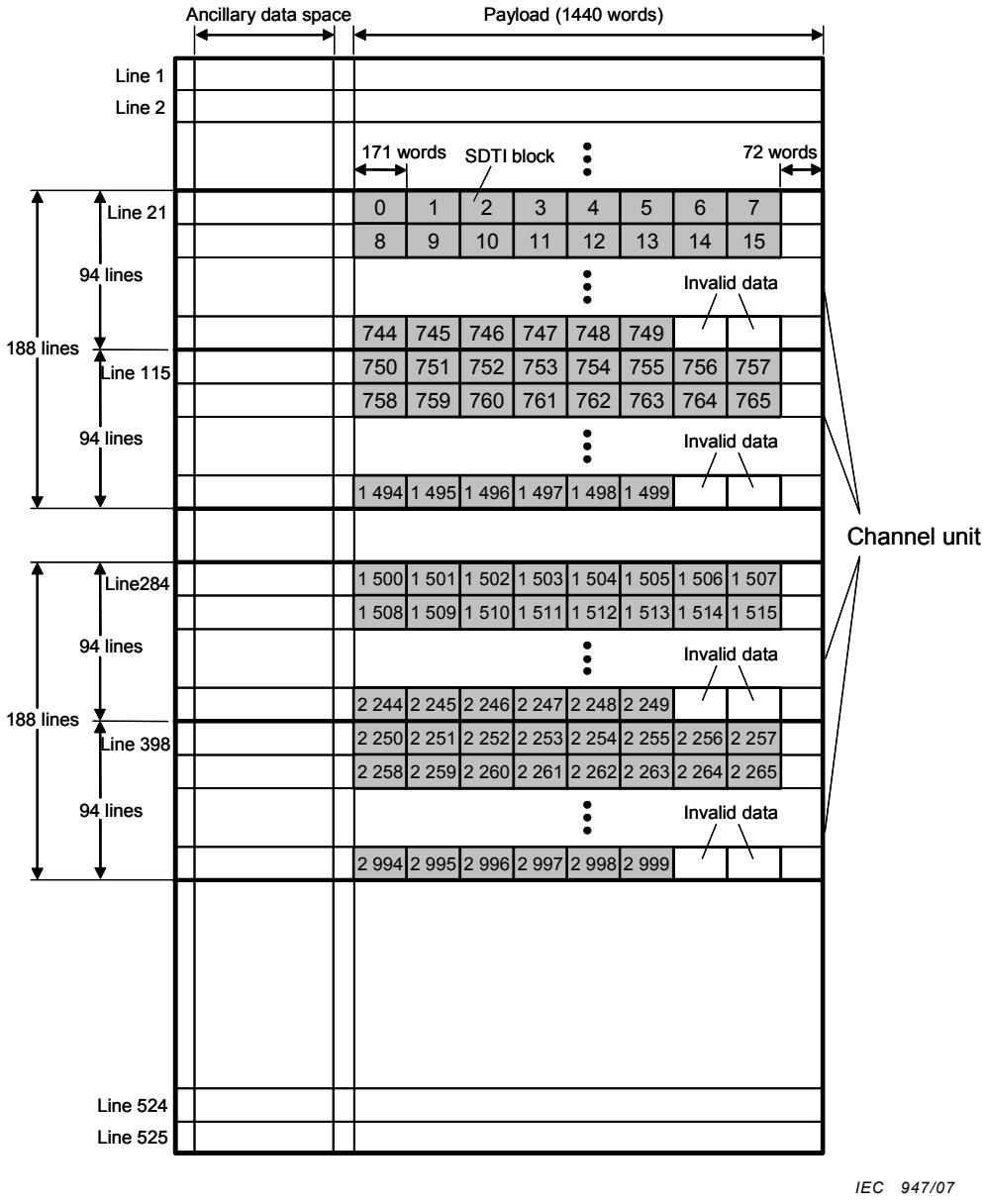



**Figure 8a – For 270 Mb/s system**

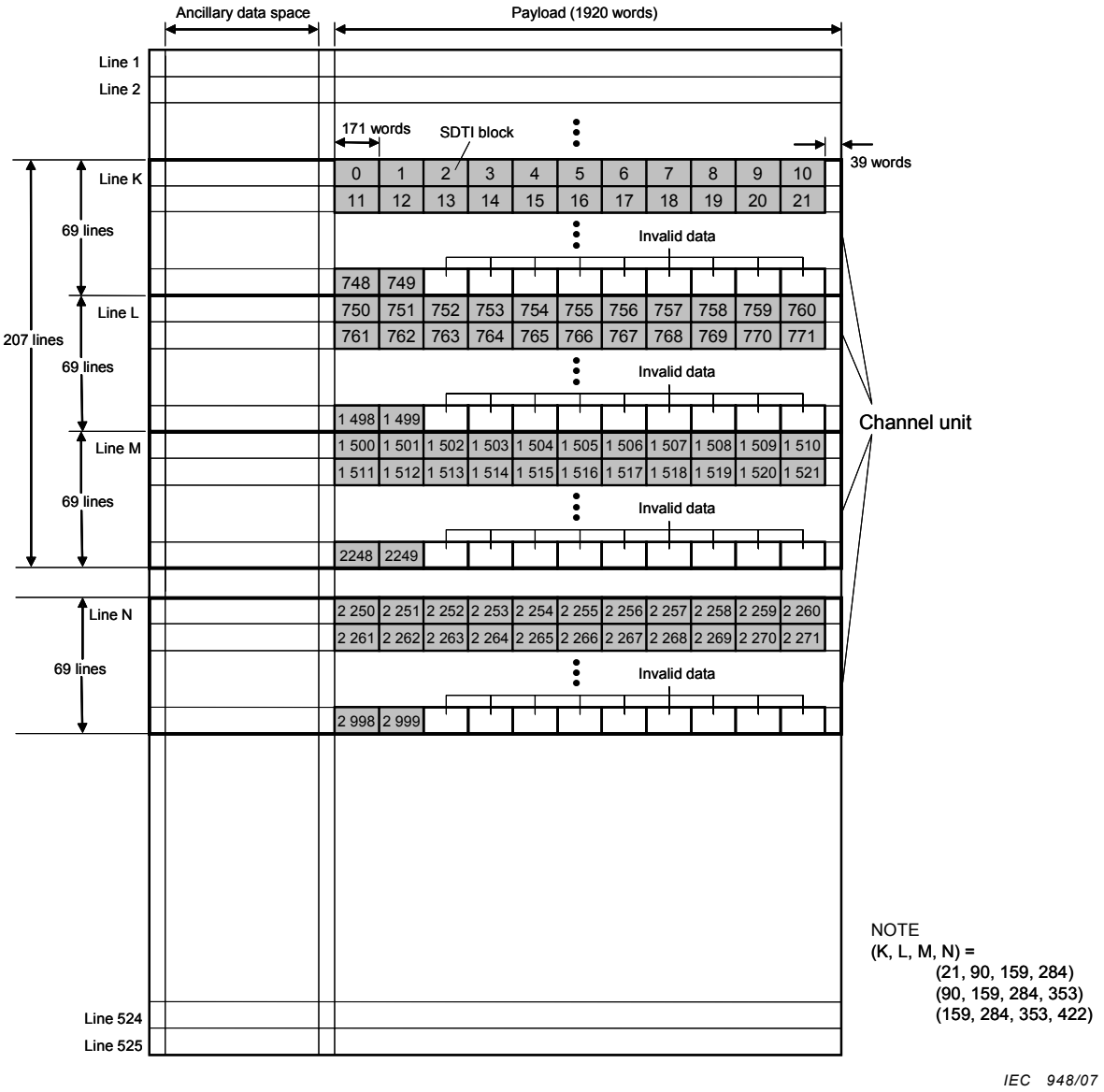



**Figure 8b – For 360 Mb/s system**

**Figure 8 – Channel unit mapping for the 100 Mb/s structure (525/60 SDTI system)**

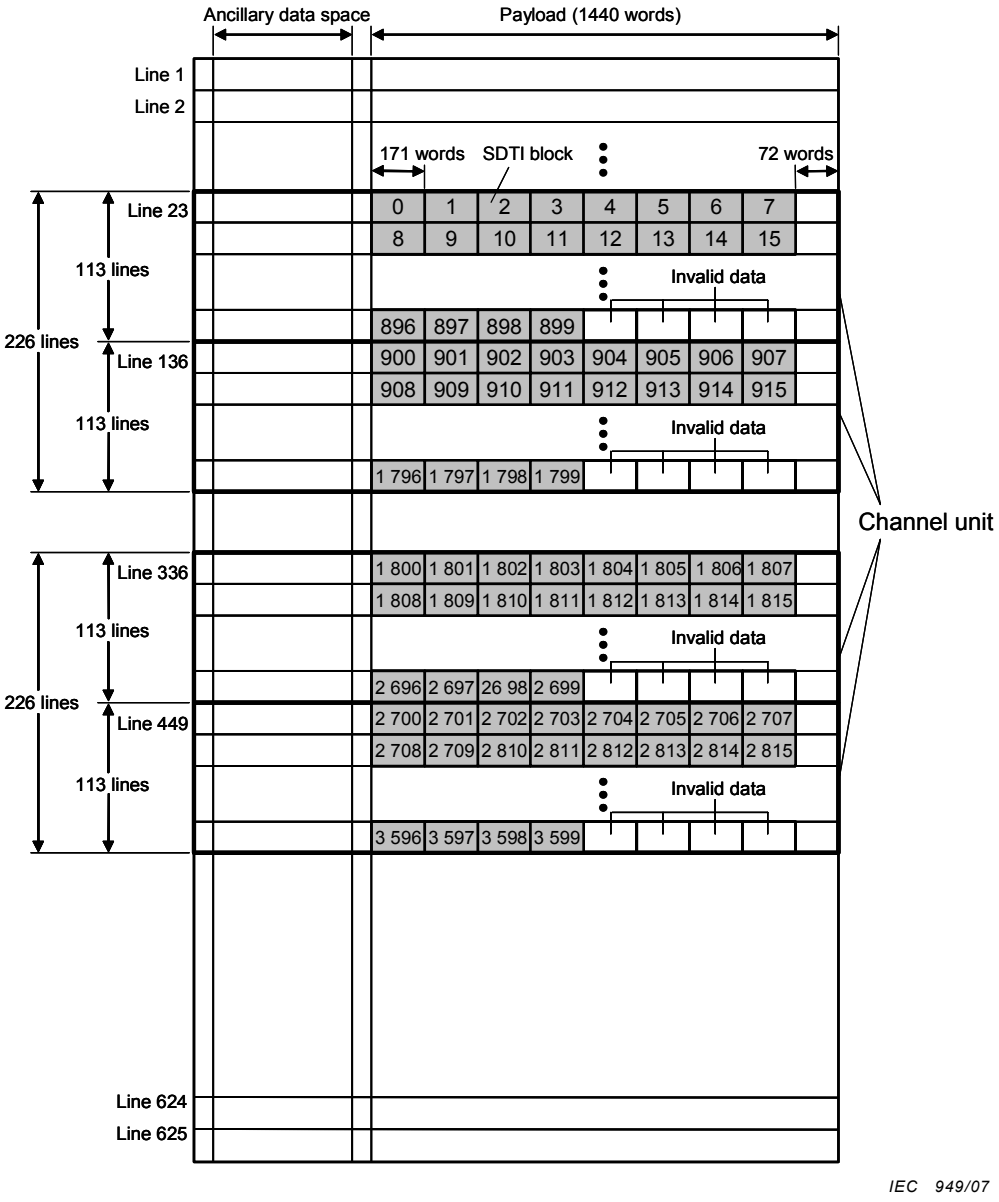



**Figure 9a – For 270 Mb/s system**

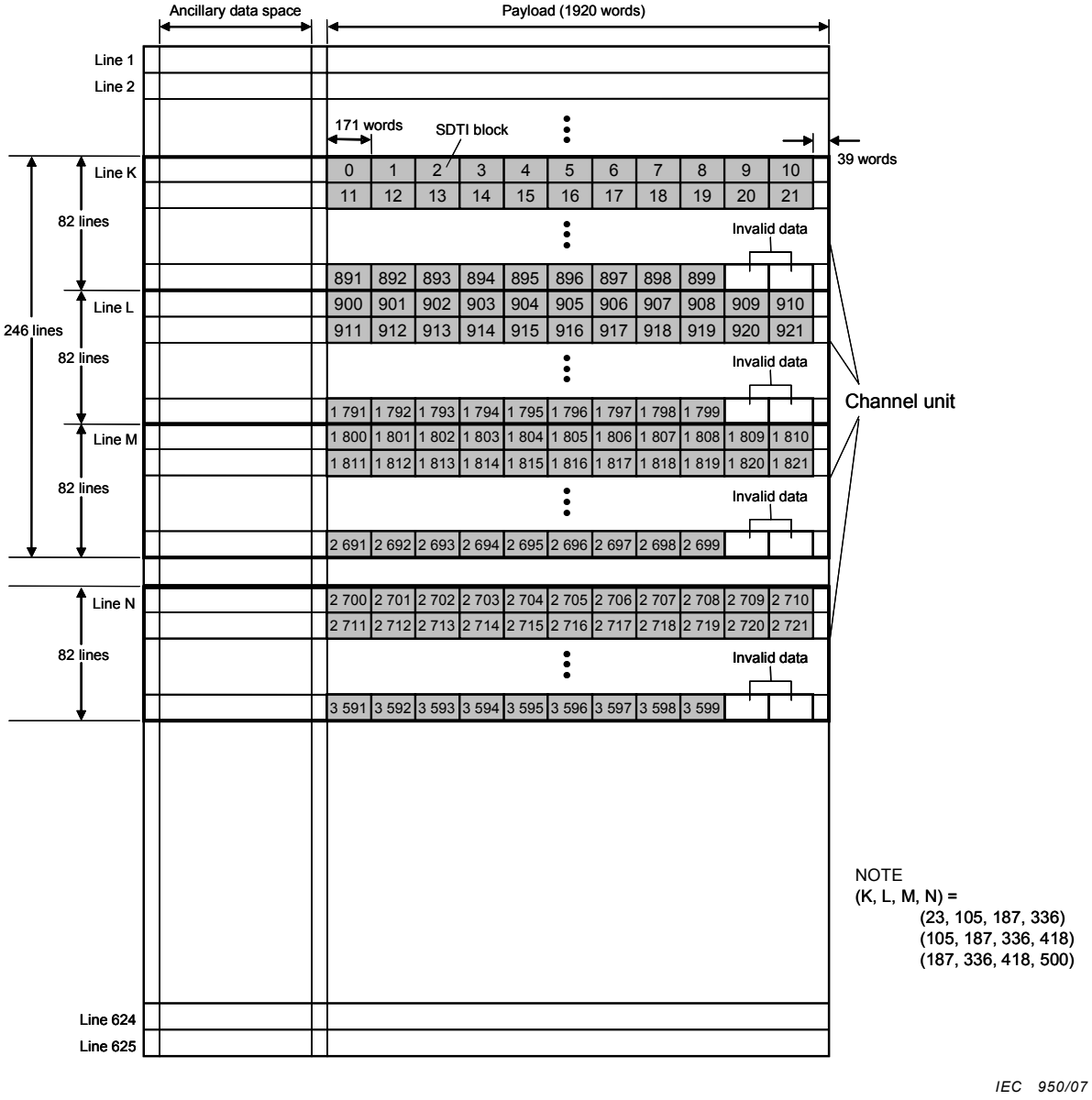



**Figure 9b – For 360 Mb/s system**

**Figure 9 – Channel unit mapping for the 100 Mb/s structure (625/50 SDTI system)**

**Table 1 – Start lines of channel units**

| | | |
|---|---|---|
| 525/60 SDI system | 270-Mb/s interface | 21, 115, 284, 378 |
| | 360-Mb/s interface | 21, 90, 159, 284, 353, 422 |
| 625/50 SDI system | 270-Mb/s interface | 23, 136, 336, 449 |
| | 360-Mb/s interface | 23, 105, 187, 336, 418, 500 |

# Annex A
(informative)

## Block diagram of D-12 recorder

Figure B.1 shows the relationship between the data stream format (this part) and other parts defining the D-12 recorder.

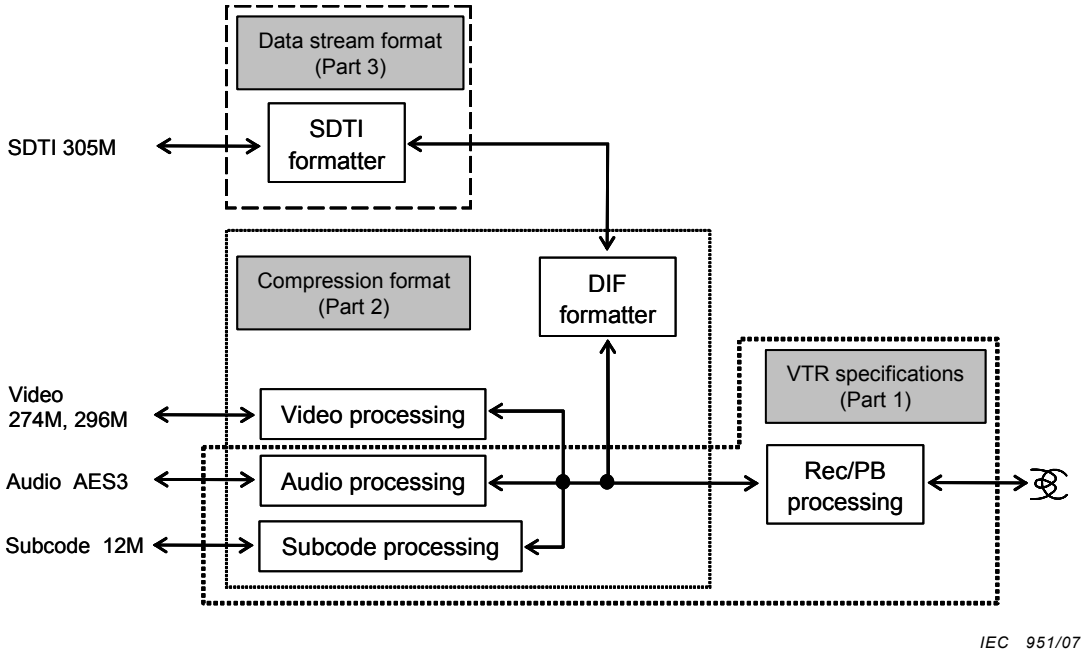



**Figure A.1 – Block diagram of D-7 recorder**

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SMPTE 291M-1998, *Television – Ancillary Data Packet and Space Formatting*

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