

for Television —  
Type D-10 Stream Specifications —  
MPEG-2 4:2:2P @ ML for  
525/60 and 625/50

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## 1 Scope

This standard specifies the compression constraints and bit-stream characteristics of an MPEG-2 video elementary stream operating at bit rates up to 50 Mb/s. One of the intended applications is to provide a bit stream compatible with the type D-10 format digital recorder. The video compression format defined and constrained by this standard is fully compliant with the MPEG-2 video standard (ISO/IEC 13818-2 [4:2:2P @ ML]).

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

SMPTE 305.2M-2000, Television — Serial Data Transport Interface (SDTI)

SMPTE 326M-2000, Television — SDTI Content Package Format (SDTI-CP)

SMPTE 328M-2000, Television — MPEG-2 Video Elementary Stream Editing Information

ISO/IEC 13818-2:2000, Information Technology — Generic Coding of Moving Pictures and Associated Audio Information: Video (MPEG-2 [Clause 6.1 describes the structure of coded video data along with a cross reference to ISO/IEC 13818-1])

## 3 Specification of the type D-10 MPEG-2 4:2:2P @ ML elementary stream

### 3.1 General characteristics

The video-ES bit stream, as defined in this standard, shall comply with the syntax of SMPTE 328M, MPEG-2 video elementary stream editing information.

In order to provide accurate editing, playback in slow-motion, and variable-speed replay including pictures in shuttle, this clause defines encoding parameter specifications suitable for the type D-10 format capable of recording MPEG video-ES streams at bit rates up to 50 Mb/s. The MPEG-2 video-ES bit stream constrained to these parameter specifications is fully compliant with the MPEG-2 video-ES syntax and can be successfully decoded by a compliant MPEG-2 4:2:2P @ ML level decoder.

### 3.2 MPEG compression parameter constraints

The compression scheme is fully compliant with ISO 13818-2, 4:2:2P @ ML. In addition, the following defined constraints shall apply:

The `bit_rate_value` in `sequence_header` shall be set with a value up to 50 Mb/s.

The `sequence_extension` parameter shall be set with the following value:

`sequence_extension: bit_rate_extension = 0h`

See table 1.

**Table 1 – Basic bit stream constraints**

Source format	SDTV 525/60/1.001 and 625/50
Bit rate	Up to 50 Mb/s constrained bytes per GOP (CBG)
GOP structure	I-picture only
Maximum coded frame size	Up to 208,541 bytes net (30/1.001 I-frames/s) Up to 250,000 bytes net (25 I-frames/s)

### 3.3 VBV\_delay constraint

The `vbv_delay` parameter shall be constrained to a 1-frame delay for each GOP by defining the following values:

#### 525/60 systems

– `picture_header: vbv_delay = 0BBBh`

#### 625/50 systems

– `picture_header: vbv_delay = 0E10h`

### 3.4 4:2:2 profile @ main level

The `sequence_extension` parameters shall be constrained to the following values:

- `sequence_extension: profile_and_level_indication = 85h` (4:2:2P @ ML)
- `sequence_extension: chroma_format = 2h` (4:2:2 format)

### 3.5 All I-picture encoding

The `picture_header` parameter shall be constrained to the following values:

- `picture_header: temporal_reference = 0h` (1 picture in a GOP)
- `picture_header: picture_coding_type = 1h` (I-picture only)

### 3.6 Picture structure is frame picture only

The `picture_coding_extension` parameter shall be set to constrain the picture coding to frame pictures only by constraining to the following value:

- `picture_coding_extension`: `picture_structure` = 3<sub>h</sub> (frame picture)

### 3.7 Frame frequency

The `sequence_header` parameters shall be constrained to the following values:

#### 525/60 systems

- `sequence_header`: `frame_rate_code` = 4<sub>h</sub> (30/1.001 Hz)

#### 625/50 systems

- `sequence_header`: `frame_rate_code` = 3<sub>h</sub> (25 Hz)

### 3.8 Picture coding parameter constraints

The picture coding constraints shall be defined as follows:

- `picture_coding_extension()`: `intra_dc_precision` = 2<sub>h</sub> (10-bit DC)
- `picture_coding_extension()`: `frame_pred_frame_dct` = 0<sub>h</sub> ( field/frame adaptive)
- `picture_coding_extension()`: `q_scale_type` = 1<sub>h</sub> (nonlinear quantizer)
- `picture_coding_extension()`: `intra_vlc_format` = 1<sub>h</sub> (use intra-VLC table)
- `picture_coding_extension()`: `alternate_scan` = 0<sub>h</sub> (zigzag scan)
- `picture_coding_extension()`: `top_field_first` = 1<sub>h</sub> (top field first only)
- `picture_coding_extension()`: `repeat_first_field` = 0<sub>h</sub> (no repeat first field)
- `picture_coding_extension()`: `progressive_frame` = 0<sub>h</sub> (interlace frames only)
- `sequence_extension()`: `progressive_sequence` = 0<sub>h</sub> (interlace frames only)

### 3.9 Slice structure

All slices shall contain only one macroblock. Each macroblock shall have a slice header as a sync code. In case of any errors occurring during transmission/recording, the error propagation will be less than one macroblock. The slice structure syntax shall be as follows:

	No.of bits	Mnemonic
slice( ) {		
slice_start_code	32	bslbf
if (vertical_size > 2800)		
slice_vertical_position_extension	3	uimsbf
if (<sequence_scalable_extension ( ) is present in the bit stream>) {		
if (scalable_mode == data partitioning) priority_breakpoint	7	uimsbf
}		
quantizer_scale_code	5	uimsbf
if (nextbits( ) == 1) {		
intra_slice_flag	1	bslbf
intra_slice	1	uimsbf
reserved_bits	7	uimsbf
while (nextbits ( ) == 1) {		
extra_bit_slice (with the value 1)	1	uimsbf
extra_information_slice	8	uimsbf
}		
}		
extra_bit_slice (with the value 0)	1	uimsbf
macroblock( )		
next_start_code( )		
}		

### 3.10 Sequence\_header and sequence\_extension

The sequence\_header and sequence\_extension shall be present for every picture (as per SMPTE 328M), specified as follows:

	No.of bits	Mnemonic
video_sequence( ) {		
next_start_code( )		
sequence_header( )		
if (nextbits( ) == extension_start_code) {		
sequence_extension( )		
do {		
extension_and_user_data(0)		
if (nextbits( ) == group_start_code) {		
group_of_pictures_header( )		
extension_and_user_data(1)		
}		
picture_header( )		
picture_coding_extension( )		
extension_and_data (2)		
picture_data( )		
if (nextbits( ) != sequence_end_code) {		
sequence_header( )		
sequence_extension( )		
}		
} while (nextbits( ) != sequence_end_code)		
} else {		
(ISO/IEC 11172-2)		
}		
sequence_end_code	32	bslbf
}		

## 4 Interfaces

An example and definition of an interface carrying the type D-10 stream is given in annexes A and C. Other interfaces may be defined in future revisions of this standard.

### Annex A (normative)

#### Type D-10 ES stream operating points

##### A.1 Operating point values

The bit stream defined in this standard is primarily intended to be a signal source compatible with the type D-10 recording format. It is possible that this same bit stream will be used in other studio applications; in particular, in those applications where it can be expected that the signal will be recorded by a VTR.

When used as a signal source for the type D-10 recording format, the bit stream is carried by SDTI-CP, as defined in SMPTE 326M, using recommended operating point bit rates as defined in this annex. Other bit rates may be used. However, users are cautioned that other system design parameters within the studio may not support all bit rates.

Table A.1 indicates recommended operating points to simplify studio operations and to provide users with a tool to be used in designing systems.

**Table A.1 – Operating points**

D-10 profile	Bit rate	sequence_header bit_rate_value	Comments
Operating point A	50 Mb/s	1E848 <sub>h</sub>	To be used when compliant with EBU D84 and D85
Operating point B	40 Mb/s	186A0 <sub>h</sub>	May be used for T3 telco circuits and other content production
Operating point C	30 Mb/s	124F8 <sub>h</sub>	May be used for E3 telco circuits, and noncritical content material

### Annex B (informative)

#### Type D-10 recording format compression model

##### B.1 Introduction

This annex specifies the recommended implementation of the compression model for the type D-10 format digital recorder with an MPEG-2 video-ES bit rate capacity of up to 50 Mb/s. This model includes the recommended input and output interfaces for the type D-10 recording format.

##### B.2 Digital recorder compression model

An internal D-10 compression encoder shall encode the baseband video input signal to an MPEG-2 video-ES at 50 Mb/s (see figure B.1).

Alternatively, the type D-10 format can record bit streams using the SDTI-CP data interface at bit rates up to and including 50 Mb/s as defined in annex A. The SDTI-CP interface extracts the MPEG-2 video-ES from the SDTI-CP stream and the type D-10 format transfers that stream transparently to the SDTI-CP output interface (or to an MPEG-2 decoder for conversion to a baseband video signal).

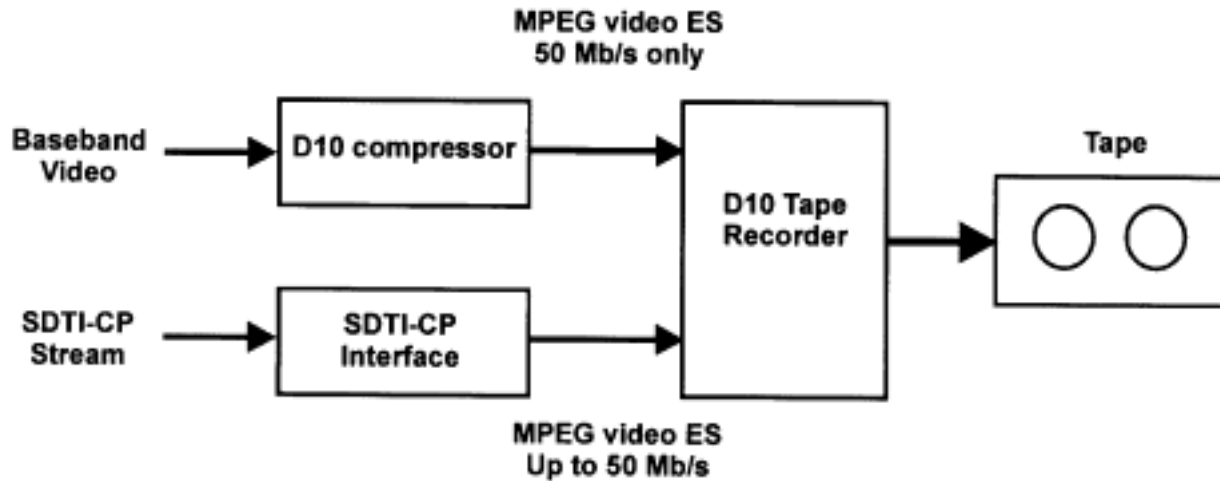


Figure B.1 – Digital recorder compression model

## Annex C (informative) Type D-10 recording format digital interfaces

### C.1 Introduction

Equipment which provides digital video, digital audio, and SDTI (SMPTE 305.2M) interfaces to the type D-10 format digital recorder is recommended to meet the following general interface specifications:

### C.2 Digital video interfaces

#### C.2.1 Encoding parameters

The digital component signal to be processed should comply with the 4:2:2 encoding parameters as defined in ITU-R BT. 656 or ANSI/SMPTE 125M operating only at 13.5 MHz luminance sampling frequency.

#### C.2.2 Serial digital video interfaces

The interface of any digital component video signal should conform to the component serial digital interface format as defined in ANSI/SMPTE 259M for both 525/60 and 625/50 systems.

### C.3 Digital audio interface

#### C.3.1 Encoding parameters

The digital audio signal should be encoded according to the following parameters:

- The sampling frequency ( $F_s$ ) shall be 48 kHz for both 525/60 and 625/50 operation.
- The resolution of each sample is 24 bits maximum.
- The audio coding is twos complement linear PCM.

NOTE – Video compression encoding may introduce delays in the video signal path; these delays may need an equivalent audio delay.

### C.3.2 Serial digital audio interface

The interface of any bit-serial digital audio bit stream should conform to AES3.

### C.4 Serial data interface

The serial data transport interface (SDTI) should conform to SMPTE 305.2M.

The SDTI data mapping format should conform to SDTI-CP defined by the following documents:

- SDTI-CP format: SMPTE 326M (SDTI content package format)
- SDTI-CP E and M: SMPTE 331M (element and metadata definitions)
- SDTI-CP templates: SMPTE RP 204 (MPEG-2 4:2:2P @ ML)

The SDTI-CP template type value should be 01<sub>h</sub>, which specifies the MPEG-2 4:2:2P @ ML baseline template as follows:

- Transfer modes: 0 (synchronous)
- Timing modes: 0 (normal) and 2 (dual)
- Multiplexing: Not supported
- FEC: Supported
- Items: System, picture, audio, and auxiliary
- SMPTE 305.2M: 270 Mb/s

## Annex D (informative) Bibliography

AES3-1992, Digital Audio Engineering — Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data

ANSI/SMPTE 125M-1995, Television — Component Video Signal 4:2:2 — Bit-Parallel Digital Interface

ANSI/SMPTE 259M-1997, Television — 10-Bit 4:2:2 Component and 4 $f_{sc}$  Composite Digital Signals — Serial Digital Interface

SMPTE 331M-2000, Television — Element and Metadata Definitions for the SDTI-CP

SMPTE 365M, Digital Television Tape Recording — 12.65-mm Type D-10 Format for MPEG-2 Component Video — 525/60 and 625/50

SMPTE RP 204-2000, SDTI-CP MPEG Decoder Templates

EBU D84-1999, Use of 50 Mbit/s MPEG Compression in Television Programme Production

EBU D85-1999, Constraints on MPEG 4:2:2 P@ML Compression to Ensure Interoperability in Television Production

ISO/IEC 11172-2:1993, Information Technology — Coding of Moving Pictures and Associated Audio for Digital Storage Media at up to about 1,5 Mbit/s — Part 2: Video

ISO/IEC 13818-1:2000, Information Technology — Generic Coding of Moving Pictures and Associated Audio Information: Systems

ITU-R BT.656-4 (02/98), Interfaces for Digital Component Signals in 525-Line and 625-Line Television Systems Operating at the 4:2:2 Level of Recommendation ITU-R BT.601 (Part A)