A.3.5 Channel code

The multiplexed data stream utilizes bi-phase mark coding (see figure 1). Synchronization is provided by a code violation consisting of 4 baud-periods low followed by 4 baud-periods high (or the inverse). The advantages of this coding scheme are that the signal is insensitive to polarity, the clock is always contained in the data, and the clock is easily recoverable with low jitter. The code violation allows for economical frame location within a period of one frame for rapid synchronization.

A.3.6 Electrical interface

The electrical interface is coaxial with a 75-ohm characteristic impedance. Connections are made with BNC-type connectors, and signal lines are terminated with 75 ohms. The output signal level is 1.0 V peak to peak ± 10%. Rise time is 5% to 30% of the baud interval. A 3-ns rise time will stay within specification for sample rates from 32 kHz to 96 kHz. This signal is very robust. Since the energy band is largely above the RC turnover frequency in typical coaxial cable, the need for cable equalization is reduced or eliminated in most situations, and jitter introduction is minimal without equalizers.

Annex B (informative)
Bibliography

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

ANSI/SMPTE 274M-1995, Television — 1920 x 1080 Scanning and Interface

ANSI/SMPTE 293M-1996, Television — 720 x 483 Active-Line at 59.94-Hz Progressive Scan Production — Digital Representation

ANSI/SMPTE 296M-1997, Television — 1280 x 720 Scanning, Analog and Digital Representation and Analog Interface

SMPTE 260M-1999, Television — 1125/60 High-Definition Production System— Digital Representation and Bit-Parallel Interface

SMPTE 320M, Television — Channel Assignments and Levels on Multichannel Audio Media

IEC 60169-8 (1978-01), Radio Frequency Connectors, Part 8: R.F. Coaxial Connectors with Inner Diameter of Outer Conductor 6.5 mm (0.256 in) with Bayonet Lock — Characteristic Impedance 50 Ohms (Type BNC)

PROPOSED SMPTE RECOMMENDED PRACTICE

RP 188
Revision of RP 188-1996

Transmission of Time Code and Control Code in the Ancillary Data Space of a Digital Television Data Stream

1 Scope

This practice defines a transmission format for conveyance of linear (LTC) or vertical interval (VITC) time code data formatted according to ANSI/SMPTE 12M in 8- or 10-bit digital television data interfaces. Time code information is transmitted in the ancillary data space as defined in SMPTE 291M. Multiple codes can be transmitted within a single digital video data stream. Other time information, such as real time clock, DTTR tape timer information, and other user-defined information, may also be carried in the ancillary time code packet instead of time code. The actual information transmitted through the interface is identified by the coding of a distributed binary bit.

2 Normative references

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

ANSI/SMPTE 12M-1995, Television, Audio and Film — Time and Control Code

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

SMPTE RP 164-1996, Location of Vertical Interval Time Code

SMPTE RP 168-1993, Definition of Vertical Interval Switching Point for Synchronous Video Switching

3 Ancillary time code format

3.1 One ancillary data packet of constant length excluding ancillary data flag shall fully represent an ancillary time code (ATC) word.

3.2 The ancillary time code packet shall be type 2, having a data identification (DID) and a secondary data identification (SDID). The DID and SDID shall be set to:

DID 60_h
SDID 60_h

3.3 The data count word for ancillary time code shall be set to:

DC 10_h

4 Format of user data words in ancillary time code packet

4.1 All user data words in the ancillary time code packets are formatted as shown in table 1.

NOTE – References to UDW bits in this practice are for a 10-bit UDW word. Correspondence between an 8-bit word and a 10-bit word is shown in table 1.

4.1.1 Bit b7 through bit b3 of the UDW_{10}-1 through UDW_{10}-16 shall contain the time code information as per ANSI/SMPTE 12M and additional coded information as shown in tables 2 and 3 of this practice.

4.2 Bit b3 of UDW_{10}-1 through UDW_{10}-16 form two groups of distributed binary bits: DBB 1 and DBB 2 (see table 3).

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Table 1 – User data words format

UDW_{10} bit (10-bit words)	UDW_8 bit (8-bit words)	Assignment
b0 (LSB)	N/A	Set to 0 in 10-bit words, N/A in 8-bit words
b1	N/A	Set to 0 in 10-bit words, N/A in 8-bit words
b2	b0	Set to 0 in 10-bit and 8-bit words
b3	b1	Distributed binary bit (DBB)
b4	b2	ANC binary group LSB
b5	b3	ANC binary group
b6	b4	ANC binary group
b7	b5	ANC binary group MSB
b8	b6	Even parity for data contained in UDW bit 7 through bit 0
b9 (MSB)	b7	Not bit 8

Table 2 – Mapping of time code data into UDW

UDW	Time code bit	Time code definitions (as per ANSI/SMPTE 12M)
1	0	Units of frames 1
	1	Units of frames 2
	2	Units of frames 4
	3	Units of frames 8
2	4	LSB binary group 1
	5	xxx binary group 1
	6	xxx binary group 1
	7	MSB binary group 1
3	8	Tens of frames 10
	9	Tens of frames 20
	10	Flag
	11	Flag
4	12	LSB binary group 2
	13	xxx binary group 2
	14	xxx binary group 2
	15	MSB binary group 2
5	16	Units of seconds 1
	17	Units of seconds 2
	18	Units of seconds 4
	19	Units of seconds 8
6	20	LSB binary group 3
	21	xxx binary group 3
	22	xxx binary group 3
	23	MSB binary group 3
7	24	Tens of seconds 10
	25	Tens of seconds 20
	26	Tens of seconds 40
	27	Flag

(continued)

Table 2 – Mapping of time code data into UDW (concluded)

UDW	Time code bit	Time code definitions (as per ANSI/SMPTE 12M)
8	28	LSB binary group 4
	29	xxx binary group 4
	30	xxx binary group 4
	31	MSB binary group 4
9	32	Units of minutes 1
	33	Units of minutes 2
	34	Units of minutes 4
	35	Units of minutes 8
10	36	LSB binary group 5
	37	xxx binary group 5
	38	xxx binary group 5
	39	MSB binary group 5
11	40	Tens of minutes 10
	41	Tens of minutes 20
	42	Tens of minutes 40
	43	Flag
12	44	LSB binary group 6
	45	xxx binary group 6
	46	xxx binary group 6
	47	MSB binary group 6
13	48	Units of hours 1
	49	Units of hours 2
	50	Units of hours 4
	51	Units of hours 8
14	52	LSB binary group 7
	53	xxx binary group 7
	54	xxx binary group 7
	55	MSB binary group 7
15	56	Tens of hours 10
	57	Tens of hours 20
	58	Flag
	59	Flag
16	60	LSB binary group 8
	61	xxx binary group 8
	62	xxx binary group 8
	63	MSB binary group 8

NOTE – Appropriate flag information for each television system as per ANSI/SMPTE 12M is inserted into the corresponding positions marked as *flag*.

Table 3 – Distributed binary bit group coding

DBB group	Bit 3 of UDW	Distributed binary bit (DBB) MSB LSB	Definition
DBB 1	UDW_{10}-1 through UDW_{10}-8	0 0 0 0 0 0 0 0	Longitudinal time code
		0 0 0 0 0 0 0 1	Vertical interval time code #1
		0 0 0 0 0 0 1 0	Vertical interval time code #2
		0 0 0 0 0 0 1 1 through 0 0 0 0 0 1 0 1	User defined
		0 0 0 0 0 1 1 0	Film data block (transferred)
		0 0 0 0 0 1 1 1	Production data block (transferred)
		0 0 0 0 1 0 0 0 through 0 1 1 1 1 1 0 0	Locally generated time address and user data (user defined)
		0 1 1 1 1 1 0 1	Video tape data block (locally generated)
		0 1 1 1 1 1 1 0	Film data block (locally generated)
		0 1 1 1 1 1 1 1	Production data block (locally generated)
		1 0 0 0 0 0 0 0 through 1 1 1 1 1 1 1 1	Reserved
DBB 2	UDW_{10}-9	b0	VITC line select LSB
	UDW_{10}-10	b1	VITC line select
	UDW_{10}-11	b2	VITC line select
	UDW_{10}-12	b3	VITC line select
	UDW_{10}-13	b4	VITC line select MSB
	UDW_{10}-14	b5	VITC line duplication
	UDW_{10}-15	b6	Time code validity
	UDW_{10}-16	b7	(User bits) process bit

4.2.1 The first group of distributed binary bits (DBB 1) is formed by bit 3 of UDW_{10}-1 through UDW_{10}-8, where UDW_{10}-1 (b3) represents the LSB and UDW_{10}-8 (b3) represents the MSB.

4.2.2 The second group of distributed binary bits (DBB 2) is formed by bit 3 of UDW_{10}-9 through UDW_{10}-16, where UDW_{10}-9 (b3) represents the LSB and UDW_{10}-16 (b3) represents the MSB.

4.3 Bits b7 through b4 form an ancillary binary group into which the time code is mapped (see tables 1 and 2). Bit b4 of the UDW_{10} represents the LSB of this group.

4.4 Information coded in the distributed binary bit group is defined in table 3.

4.4.1 Bits b4 through b0 of the distributed binary bit group DBB 2 convey VITC line number location indicating the position of VITC data on the output digital video signal interface within the vertical blanking interval. The line select number depends on the television system and shall be constrained to a range as shown in table 4.

4.4.2 Bit b5 of DBB 2 when set to 1 shall signify that the VITC word carried in the ancillary time code word, when converted to an analog video output signal, shall be inserted on the selected line number and shall be repeated again on the selected line number + 2 (see table 4, bit b5 = 1).

4.4.3 Bits b7 and b6 of the DBB 2 word represent different time code condition bits (see table 3). Data errors indicated by the error detection system of the received time code signal at the input receiving interface to the ancillary time code formatter and the type of processing of received user bits shall be signaled by these bits in the transmitted ATC word. The coding of these two bits is shown in table 5.

Table 4 – Line select number

DBB 2 bits b4 through b0					VITC line select 525/60 bit b5 = x VITC on line N	525/60 bit b5 = 1 Repeated VITC on line (N+2)	625/50 bit b5 = x VITC on line N	625/50 bit b5 = 1 Repeated VITC on line (N+2)
b4	b3	b2	b1	b0	field 1/field 2	field 1/field 2	field 1/field 2	field 1/field 2
0	0	1	1	0	–	–	6/319	8/321
0	0	1	1	1	–	–	7/320	9/322
0	1	0	0	0	–	–	8/321	10/323
0	1	0	0	1	–	–	9/322	11/324
0	1	0	1	0	10/273	12/275	10/323	12/325
0	1	0	1	1	11/274	13/276	11/324	13/326
0	1	1	0	0	12/275	14/277	12/325	14/327
0	1	1	0	1	13/276	15/278	13/326	15/328
0	1	1	1	0	14/277	16/279	14/327	16/329
0	1	1	1	1	15/278	17/280	15/328	17/330
1	0	0	0	0	16/279	18/281	16/329	18/331
1	0	0	0	1	17/280	19/282	17/330	19/332
1	0	0	1	0	18/281	20/283	18/331	20/333
1	0	0	1	1	19/282	–	19/332	21/334
1	0	1	0	0	20/283	–	20/333	22/335
1	0	1	0	1	–	–	21/334	–
1	0	1	1	0	–	–	22/335	–

NOTE – x = irrelevant.

Table 5 – Coding of validity and process bits

Time code validity bit (b6) and process bit (b7)	Definition
b6 = 0	No time code error received or locally generated time code address
b6 = 1	Transmitted time code interpolated from previous time code (received a time code error)
b7 = 0	Binary groups of user bits in time code data stream are processed to compensate for latency
b7 = 1	Binary groups of user bits in time code data stream are only retransmitted (no delay compensation)

4.5 Mapping of the time code data into the UDW 1 through UDW 16 of the ancillary time code data packet is shown in table 2.

4.5.1 The mapping of film transfer information (i.e., video tape, film, and production data blocks) into VITC space is defined in SMPTE RP 201.

5 Transmission of ancillary time code packets

5.1 Multiple transmissions of ancillary time code packets per video frame code information are permissible under the provisions of this practice.

NOTE – This provision permits transmission of different ATC packets within a single video frame; as, for example, an ATC packet containing LTC information and a second ATC packet containing VITC information. The time code information in these two packets shall correspond to the relevant video frame (see 6.3).

5.2 Transmission of ancillary time code packets shall be at least once per frame for LTC data word and twice per frame for VITC data word.

5.2.1 Only the 64 information bits of time code are transferred to the ATC. The LTC sync word (bits 64-79) and the VITC(1/0) sync bit pairs and CRC word are omitted from the ancillary time code packets.

6 Ancillary time code packets location

6.1 Insertion of ancillary time code (ATC) packets into any available location in the digital data stream is permitted under the provisions of this practice.

6.2 The preferred location for insertion of ancillary time code (ATC) packets into a digital video signal stream shall be within the available ancillary space located within vertical blanking after the vertical interval switching point defined in SMPTE RP 168 and before the beginning of active video.

NOTE – Users should be aware that with single-frame capture, the decoded LTC or VITC may be corrupted regardless of the ATC packet location within the frame.

6.3 Frame or field address information (LTC or VITC) contained in an ATC packet shall correspond to the respective video frame or field in which the ATC packet resides. Look-ahead compensation shall be applied to the time code (LTC or VITC) frame count when converting ancillary time code residing within the vertical blanking interval, as defined by the line standard in use, to a location before the vertical interval switching point defined in SMPTE RP 168.

6.3.1 Transmission of the VITC word for field 1 or field 2 in the ATC is signaled using the appropriate field flag defined by ANSI/SMPTE 12M. However, when ATC is converted to VITC according to 4.4.1 and table 4, the field flag of the VITC data shall be set according to the field in which the output is inserted.

Annex A (informative)
Packet location

Some existing HDTV equipment requires that ATC packets are located in specific default locations of a frame. These default locations, as identified by ARIB for the 1125/2:1 system, are shown in table A.1.

Table A.1 – Default locations

Type of time code	Default locations for 1125/2:1 system
LTC packet	Horizontal ancillary space of line 10
VITC 1 packet	Horizontal ancillary space of line 9
VITC 2 packet	Horizontal ancillary space of line 571
Other packets	Any available ancillary space except lines 9, 10, and 571

Annex B (informative)
Bibliography

SMPTE RP 159-1995, Vertical Interval Time Code and Longitudinal Time Code Relationship

SMPTE RP 201, Encoding Film Transfer Information Using Vertical Interval Time Code

ITU-R BT.1366, Transmission of Time Code and Control Code in the Ancillary Data Space of a Digital Television Stream According to ITU-R BT.656, ITU-R BT.799, and ITU-R BT.1120

PROPOSED SMPTE RECOMMENDED PRACTICE

RP 201

Encoding Film Transfer Information Using Vertical Interval Time Code

1 Scope

This practice specifies a method of encoding video tape time code, film edge numbers, and production time code into 3 vertical interval time code lines. This practice is intended for use in post-production as a means of conveying the essential address elements that define the film to tape transfer. Normally this information will not be in the final program version. This practice defines the encoding in two parts; the first part specifies the data that will be encoded and the second part specifies specific methods of encoding the data into 3 vertical interval lines for analog and digital video signals, and into digital video ancillary data time code.

2 Normative references

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

ANSI/SMPTE 12M-1995, Television, Audio and Film — Time and Control Code

ANSI/SMPTE 266M-1994, Television — 4:2:2 Digital Component Systems — Digital Vertical Interval Time Code

ANSI/SMPTE 270-1994, Motion-Picture Film (65-mm) — Manufacturer-Printed Latent Image Identification Information

ANSI/SMPTE 271-1994, Motion-Picture Film (16-mm) -- Manufacturer-Printed Latent Image Identification Information

SMPTE 254-1998, Motion-Picture Film (35-mm) — Manufacturer-Printed Latent Image Identification Information

SMPTE 313-1998, Motion-Picture Film (65-mm) — Manufacturer-Printed Latent Image Identification Information — 120 Perforation Repeat

SMPTE RP 188-1996, Transmission of Time Code and Control Code in the Ancillary Data Space of a Digital Television Data Stream

SMPTE RP 195-1998, Use of the Reference Mark in Manufacturer-Printed Latent Image Key Numbers for Unambiguous Film Frame Identification

3 Definitions and glossary

3.1 Terms defined by SMPTE 254, ANSI/SMPTE 270, ANSI/SMPTE 271, and SMPTE 313

3.1.1 key number: A number, sometimes referred to as an edge number or footage number, that is printed with ink or exposed onto the film at the time of manufacture. The numbers are placed at regular intervals — typically one foot. Film that conforms to SMPTE 254, ANSI/SMPTE 270, ANSI/SMPTE 271, or SMPTE 313 use a 12-character alphanumeric key number. For the purposes of this practice, references to key number will refer to the machine-readable key number.

3.1.2 key number repetition rate: The interval at which key numbers repeat on the film stock, measured in perforations.

3.2 Terms defined by SMPTE RP 195

3.2.1 frame repetition rate: The interval at which exposed film images occur along the film, measured in perforations.

3.3 Terms defined by this practice

3.3.1 film feet: The least significant 4 digits of the key number. This number increments every *n* frame where *n* is calculated by dividing the key number repetition rate by the frame repetition rate.

3.3.2 film prefix: The part of the key number that is not contained in film feet. This number is used to identify the stock or batch of film. Normally this number does not increment during a single roll of film.

3.3.3 film frame offset: This is the frame offset away from the key number. It is not included as part of the key number. SMPTE RP 195 specifies the procedure for unambiguously identifying the film frame numbers from exposed latent-image key numbers.

3.3.4 feet frame count: This is the number of film frames in the current film foot. For film formats where the key number repetition rate is not evenly divisible by the frame repetition rate, the feet frame count identifies which foot has an extra frame.

4 Definition of the data blocks

The encoded data are split into three distinct blocks of data — video tape data, film data, and production data.

4.1 Video tape data block

The video tape data block contains the video tape time information in the time bits. The frame rate of this time code will be 25 frame-per-second time for 625/50 systems, and 29.97 frame-per-second drop frame or nondrop frame for 525/60 systems.

The contents of the user bits will be the VTR user bits or video tape reel number, or any arbitrary hexadecimal values.

4.2 Film data block

The film data block contains the key number information from the film, as well as information specifying the film format and pulldown of the transferred frame.

The time bits of the film data block are used to store the pulldown flags, film manufacturer, film gauge, emulsion type, and part of the film prefix. The user bits contain the remainder of the film prefix, the film feet, the film frame offset, and the feet frame count.

Film manufacturer and type IDs are encoded as a hexadecimal nibble. Film emulsion, prefix, and footage are encoded as a pair of packed BCD digits. Frame count is encoded as a binary number. The remainder of the information is bitmap encoded as shown in tables 1 to 5.

Name	Contents
Pulldown	A bitmapped nibble comprised of 3 pulldown flags plus the video field flag. The 3 pulldown flags, PD1, PD2, and PD3, encode the pulldown of the film frame with respect to the video (see tables 2 to 5). The field flag FLD encodes video field information required to make the pulldown complete (0 is encoded for field 1; 1 is encoded for field 2).
Film manufacturer and type ID	A hexadecimal nibble which describes the manufacturer and the type of film being used (see table 1).
Film emulsion type	A packed BCD digit pair containing the film emulsion type corresponding to the encoded values recovered from the machine-readable bar code (and not the letter codes on the human-readable part of the edge number). When ink numbers are used, the film emulsion type contains the decimal ASCII values of the letter suffix in the ink number prefix. If no letter suffix is used, the decimal ASCII for a space (32) shall be encoded.
Film prefix	Six BCD digits containing the film prefix.
Film feet	Four BCD digits containing the film feet.
Feet frame count	Two bits (FFC2 and FFC1) containing the feet frame count (see table 1).
Film frame offset	Six bits containing the film frame offset.

4.2.1 Film manufacturer and type ID

See table 1.

Table 1 – Film types and feet frame counts

Manufacturer ID	Film Manufacturer	Format	Feet frame count	FCC2	FCC1
0	Ink (see note)	35 mm (4 perf)	16	0	0
		16 mm	20	1	0
		16 mm	40	0	1
			Reserved	1	1
1	Agfa	35 mm	16 (4 perf)	0	0
2	Kodak		21 (3 perf dot at head – perf 1)	1	0
3	Fuji		21 (3 perf dot in center – perf 2)	0	1
			22 (3 perf dot at tail – perf 3)	1	1
4	Agfa	Special formats	8 (35 mm) 8 perf – Vistavision)	0	0
5	Kodak		24 (65 mm/120 5 perf 60 FPS)	1	0
6	Fuji		Reserved	0	1
			Reserved	1	1
7	Fuji	65/70 mm (120 perf key number cycle)	24 (5 perf)	0	0
8	Kodak		15 (8 perf)	1	0
			12 (10 perf)	0	1
			8 (15 perf)	1	1
9	Fuji	65/70 mm (80 perf key number cycle)	16 (5 perf)	0	0
A	Kodak		10 (8 perf)	1	0
			8 (10 perf)	0	1
			Reserved	1	1
B	Agfa	16 mm	Reserved	0	0
C	Kodak		20 (key number and frames)	1	0
D	Fuji		40 (foot and frames)	0	1
			Reserved	1	1
E	Reserved				
F	Reserved				

NOTE – Film manufacturer 0 is reserved to denote ink numbers which are applied during post production. They do not correspond to any specific manufacturer.

4.2.2 Pulldown

Three pulldown flags (PD3, PD2, and PDI) uniquely identify any of the video frames that can result from the pulldown sequence. Note that the flags do not change in the middle of a video frame. These flags are encoded along with the video field flag (FLD) to form the pulldown nibble.

Name	Description
PD3, PD1	Used to identify uniquely the pulldown sequence.
PD2	0 = video frame containing the same film image in both fields 1 = video frame containing different film images in each field
FLD	0 = video field 1 1 = video field 2

Table 2 – 23.98 fps pulldown flags — 525/60 systems

Film frame	FLD (MSB)	PD3	PD2	PD1 (LSB)	Nibble value	Video frame example
A	0	1	0	0	4	0:00
	1	1	0	0	C	
B	0	1	0	1	5	0:01
	1	1	0	1	D	
	0	0	1	1	3	0:02
C	1	0	1	1	B	
	0	0	1	0	2	0:03
D	1	0	1	0	A	
	0	0	0	0	0	0:04
	1	0	0	0	8	
A	0	1	0	0	4	0:05
	1	1	0	0	C	

Table 3 – 29.97 fps and 25 fps field 1 dominant pulldown flags

Film frame	FLD (MSB)	PD3	PD2	PD1 (LSB)	Nibble value	Video frame example
A	0	0	0	1	1	0:01
	1	0	0	1	9	
A	0	0	0	1	1	0:02
	1	0	0	1	9	

Table 4 – 29.97 fps and 25 fps field 2 dominant pulldown flags

Film frame	FLD (MSB)	PD3	PD2	PD1 (LSB)	Nibble value	Video frame example
C6	0	1	1	1	7	0:01
C7	1	1	1	1	F	
	0	1	1	1	7	0:02
C8	1	1	1	1	F	

Table 5 – 24 fps pulldown flags — 625/50 systems

Film frame	FLD (MSB)	PD3	PD2	PD1 (LSB)	Nibble value	Video frame example
A1	0	1	0	0	4	0:00
	1	1	0	0	C	
A2	0	1	0	0	4	0:01
	1	1	0	0	C	
A3	0	1	0	0	4	0:02
	1	1	0	0	C	
A4	0	1	0	0	4	0:03
	1	1	0	0	C	
A5	0	1	0	0	4	0:04
	1	1	0	0	C	
A6	0	1	0	0	4	0:05
	1	1	0	0	C	
A7	0	1	0	0	4	0:06
	1	1	0	0	C	
A8	0	1	0	0	4	0:07
	1	1	0	0	C	
A9	0	1	0	0	4	0:08
	1	1	0	0	C	
A10	0	1	0	0	4	0:09
	1	1	0	0	C	
A11	0	1	0	0	4	0:10
	1	1	0	0	C	
B1	0	1	0	1	5	0:11
	1	1	0	1	D	
	0	0	1	1	3	0:12
C1	1	0	1	1	B	
	0	1	1	0	6	0:13
C2	1	1	1	0	E	
	0	1	1	0	6	0:14
C3	1	1	1	0	E	
	0	1	1	0	6	0:15
C4	1	1	1	0	E	
	0	1	1	0	6	0:16
C5	1	1	1	0	E	
	0	1	1	0	6	0:17
C6	1	1	1	0	E	
	0	1	1	0	6	0:18
C7	1	1	1	0	E	
	0	1	1	0	6	0:19
C8	1	1	1	0	E	
	0	1	1	0	6	0:20
C9	1	1	1	0	E	
	0	1	1	0	6	0:21
C10	1	1	1	0	E	
	0	1	1	0	6	0:22
C11	1	1	1	0	E	
	0	0	1	0	2	0:23
D1	1	0	1	0	A	
	0	0	0	0	0	0:24
	1	0	0	0	8	

4.2.3 Film data block example

For a sample 35-mm (4 perf) key number KJ12 3456 7890+12

Manufacturer's code: 2 – Letter code K for Kodak is encoded as 2 for 35-mm
Film type: 96 – Film type 5296 has letter code J
Prefix: 123456
Footage: 7890
Frames: C – Binary representation of 12 frames
Pulldown: 4 – A frame pulldown and field 1

5 Production data block

The production data block contains the production time code in the time bits which are encoded in a format similar to ANSI/SMPTE 12M. The user bits of the production data block shall contain the in-camera or audio time and frame count.

The default frame rate of production time code will be 25 fps for 625/50 systems, and 29.97 fps drop frame or nondrop frame for 525/60 systems. The frame rate is encoded into two flag bits as follows:

PFR2	PFR1	Frame rate
0	0	24 / 23.98
1	0	25
0	1	29.97
1	1	Other (manually set up on reader)

The user bits will normally contain the user bits of the audio time code or in-camera time code. Two flag bits are used to indicate the format of the user bit encoding as follows:

UBF2	UBF1	User bit encoding format
0	0	Not encoded (8 hexadecimal digits)
0	1	Encoded according to date/camera ID format (see below)
1	0	Reserved
1	1	Reserved

The date/camera ID format of the user bits is defined as follows:

- The year (00-99) is encoded into 7 bits
- The month (01 to 12) is encoded into 4 bits
- The day (01 to 31) is encoded into 5 bits
- Each camera ID digit is a hexadecimal digit containing values 0 to F. The full camera ID is 4 hexadecimal digits.

6 Encoding the data into 3 VITC lines

6.1 Format overview

The encoded data shall be contained in a block of three consecutive lines of the vertical interval. There shall be an optional block of 3 lines for redundancy. Although the actual choice of lines is up to the user, the line ranges in table 6 are recommended.

The first line of the block shall be defined as the one occurring closer to vertical sync (i.e., for a block in lines 14-16, line 14 shall be the first line). The block of VITC lines shall contain the data given in table 7.

Table 6 – Recommended line numbers

	525/60	625/50
Block 1	14-15-16 (277-278-279)	14-15-16 (327-328-329)
Block 2 (optional)	17-18-19 (280-281-282)	19-20-21 (332-333-334)

Table 7 – Data encoding into VITC lines

	Time bits	User bits	CRC
First line	VTR time	VTR user bits or hexadecimal digits	Normal
Second ine	Key number prefix	Key number count + frames	Inverted
Third line	Production time	ATR / In-camera user bits	Special

The video tape data line (first line) shall be encoded with the normal ANSI/SMPTE 12M CRC checkword so that existing VITC readers built into the tape machines can access this information. Each of the other two lines shall be encoded with their own unique CRC so that there will not be any confusion from existing VITC readers as to the meaning of the three sets of data. The film data line (second line) CRC will be the inverse of the ANSI/SMPTE 12M CRC. The production data line (third line) CRC has the high-order nibble inverted.

The following clauses give the specific details of the encoding of each line.

6.2 First line — Video tape data block

The video tape data block is encoded into the first line using standard ANSI/SMPTE 12M format encoding. The CRC of this line will be the normal ANSI/SMPTE 12M CRC.

6.3 Second line — Film data block

The film data block is encoded into the second line. The CRC shall be the ones complement of the normal ANSI/SMPTE 12M CRC. Table 8 shows how the film data block is mapped into the VITC bits of the line.

6.4 Third line — Production data block

The production data block is encoded into the third line in a format similar to ANSI/SMPTE 12M. The CRC shall be calculated in the same way as the normal ANSI/SMPTE 12M CRC, but will have the high-order nibble inverted. Table 9 shows how the production data block is mapped to the VITC bits.

When the user bits are encoded to the date/camera/ID format (see clause 5), the data shall be mapped to the VITC bits as given in table 9.

7 Encoding the data into ancillary data space

7.1 Format overview

The encoded data shall be contained in three ancillary data time code packets per field as defined in SMPTE RP 188. Table 10 shows the recommended line numbers that are to be encoded.

The data is mapped into ancillary data time code packets as shown in table 11.

The following clauses give the specific details of the encoding of each of the data blocks.

Table 8 – Film data block mapping into VITC bits

Time nibbles	VITC bit number	Contents
Hours tens	72-75	Pulldown (see tables 2 to 5)
Hours units	62-65	Film manufacturer and type ID (see table 1)
Minutes tens	52-55	Film emulsion type 1 (MS digit)
Minutes units	42-45	Film emulsion type 2 (LS digit)
Seconds tens	32-35	Prefix 1 (MS digit)
Seconds units	22-25	Prefix 2
Frames tens	12-15	Prefix 3
Frames units	02-05	Prefix 4
User bit group	**VITC bit number**	**Contents**
Group 8 (hours tens)	76-79	Prefix 5
Group 7 (hours units)	66-69	Prefix 6 (LS digit)
Group 6 (minutes tens)	56-59	Footage 1 (MS digit)
Group 5 (minutes units)	46-49	Footage 2
Group 4 (seconds tens)	36-39	Footage 3
Group 3 (seconds units)	26-29	Footage 4 (LS digit)
Group 2 (frames tens)	18-19	Feet frame count
	16-17	Frames 2 MSB
Group 1 (frames units)	06-09	Frames 4 LSB

Table 9 – Production data block mapping into VITC bits

Time nibbles	VITC bit number	Contents
Hours tens	75	PFR2, frame rate flag 2
	74	PFR1, frame rate flag 1
	72-73	Hours tens of production time (0-2)
Hours units	62-65	Hours units of production time
Minutes tens	55	UBF2, user bit format flag 2
	52-54	Minutes tens of production time (0-5)
Minutes units	42-45	Minutes units of production time
Seconds tens	35	UBF1, user bit format flag 1
	32-34	Seconds tens of production time (0-5)
Seconds units	22-25	Seconds units of production time
Frames tens	15	Reserved, set to zero
	14	Production time drop frame flag
	12-13	Frames tens of production time
Frames units	02-05	Frames units of production time
User bit group	**VITC bit number**	**Contents**
Group 8 (hours tens)	76-79	Year, 4 MS bits
Group 7 (hours units)	67-69	Year, 3 LSB
	66	Month, MSB
Group 6 (minutes tens)	57-59	Month, 3 LSB
	56	Day, MSB
Group 5 (minutes units)	46-49	Day 4 LSB
Group 4 (seconds tens)	36-39	Camera ID 1 (MS digit)
Group 3 (seconds units)	26-29	Camera ID 2
Group 2 (frames tens)	16-19	Camera ID 3
Group 1 (frames units)	06-09	Camera ID 4 (LS digit)

Table 10 – Recommended line numbers ancillary time code

	525/60	625/50
Video tape data block	14 (277)	14 (327)
Film data block	15 (278)	15 (328)
Production data block	16 (279)	16 (329)

Table 11 – Data encoding into ancillary data

	Time bits	User bits	RP 188 DBB1 Coding (hex values) transferred from reader	RP 188 DBB1 Coding (hex values) locally generated
Video tape data block	VTR time	VTR user bits or hexadecimal digits	01	7D
Film data block	Key number prefix	Key number count + frames	06	7E
Production data block	Production time	ATR / In-camera user bits	07	7F

7.2 Video tape data block

The video tape data block is encoded as normal vertical interval time code. The bit definitions are defined in SMPTE RP 188.

7.3 Film data block

The film data block is encoded with DBB1 code of 06 (hex) when the data are being transferred from a reader device on the ANC formatter or 7E (hex) when it is a locally generated code in the ANC formatter. Table 12 shows how the film data block is mapped into the time code bits. SMPTE RP 188 defines how these bits are mapped into the ANC time code packets.

7.4 Production data block

The production data block is encoded with a DBB1 code of 07 (hex) when the data are being transferred from a reader device on the ANC formatter or 7F (hex) when it is a locally generated code in the ANC formatter. Table 13 shows how the film data block is mapped into the time code bits. SMPTE RP 188 defines how these bits are mapped into the ANC time code packets.

When the user bits are encoded to the date/camera/ID format (see clause 5), the data shall be mapped as given in table 13.

Table 12 – Film data block mapping

Time nibbles	VITC bit number	Contents
Hours tens	56-59	Pulldown (see tables 2 to 5)
Hours units	48-51	Film manufacturer and type ID (see table 1)
Minutes tens	40-43	Film emulsion type 1 (MS digit)
Minutes units	32-35	Film emulsion type 2 (LS digit)
Seconds tens	24-27	Prefix 1 (MS digit)
Seconds units	16-19	Prefix 2
Frames tens	08-11	Prefix 3
Frames units	00-03	Prefix 4
User bit group	**VITC bit number**	**Contents**
Group 8 (hours tens)	60-63	Prefix 5
Group 7 (hours units)	52-55	Prefix 6 (LS digit)
Group 6 (minutes tens)	44-47	Footage 1 (MS digit)
Group 5 (minutes units)	36-39	Footage 2
Group 4 (seconds tens)	28-31	Footage 3
Group 3 (seconds units)	20-23	Footage 4 (LS digit)
Group 2 (frames tens)	14-15	Feet frame count
	12-13	Frames 2 MSB
Group 1 (frames units)	04-07	Frames 4 LSB

Table 13 – Production data block mapping

Time nibbles	VITC bit number	Contents
Hours tens	59	PFR2, frame rate flag 2
	58	PFR1, frame rate flag 1
	56-57	Hours tens of production time (0-2)
Hours units	48-51	Hours units of production time
Minutes tens	43	UBF2, user bit format flag 2
	40-42	Minutes tens of production time (0-5)
Minutes units	32-35	Minutes units of production time
Seconds tens	27	UBF1, user bit format flag 1
	24-26	Seconds tens of production time (0-5)
Seconds units	16-19	Seconds units of production time
Frames tens	11	Reserved, set to zero
	10	Production time drop frame flag
	08-09	Frames tens of production time
Frames units	00-03	Frames units of production time
User bit group	**VITC bit number**	**Contents**
Group 8 (hours tens)	60-63	Year, 4 MS bits
Group 7 (hours units)	53-55	Year, 3 LSB
	52	Month, MSB
Group 6 (minutes tens)	45-47	Month, 3 LSB
	44	Day, MSB
Group 5 (minutes units)	36-39	Day, 4 LSB
Group 4 (seconds tens)	28-31	Camera ID 1 (MS digit)
Group 3 (seconds units)	20-23	Camera ID 2
Group 2 (frames tens)	12-15	Camera ID 3
Group 1 (frames units)	04-07	Camera ID 4 (LS digit)

Annex A (informative)
Calculating the modified CRC

This annex contains additional information on encoding the modified CRCs used for the film data block and the production data block.

A.1 Calculating film data block CRC

The normal ANSI/SMPTE 12M CRC is calculated first. The resulting 8-bit CRC is exclusive-ored with the hexadecimal value 0FF to obtain the film data block CRC.

A.2 Calculating production data block CRC

The normal ANSI/SMPTE 12M CRC is calculated first. The resulting 8-bit CRC is exclusive-ored with the hexadecimal value 0F0 to obtain the production data block CRC.