SMPTE ST 266:2012
Revision of
SMPTE 266M-2002

SMPTE STANDARD

SD Digital Component Systems — Digital Vertical Interval Time Code

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Approved
April 18, 2012

Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices, and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in Part XIII of its Administrative Practices.

SMPTE ST 266 was prepared by Technology Committee 32NF.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Standard. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

Introduction

This section is entirely informative and does not form an integral part of this Engineering Document.

This revision of this document brings it into conformance with current SMPTE language and nomenclature requirements. It also recommends the use of SMPTE ST 12-2 as the time code standard for new implementations.

The preferred method to carry SMPTE ST 12-1 time code in digital systems is per SMPTE ST 12-2, Ancillary Time Code (ATC). This method is equally applicable to both Standard Definition and High Definition image formats. The use of D-VITC in new systems is discouraged.

1 Scope

This standard defines the digital data representation of the digitized values of the Digital Vertical Interval (VITC) code words defined in SMPTE ST 12-1. The intended use is with the standard definition (SD) digital coding given in SMPTE ST 125 (for 525-line, 59.94-Hz field rate, SD Digital component signals) or Recommendation ITU-R BT.601-7 and Recommendation ITU-R BT.656 (for 625-line, 50-Hz field rate, SD Digital component signals).

2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword “reserved” indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword “forbidden” indicates “reserved” and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; Tables shall be next; followed by formal languages; then figures; and then any other language forms.

3 Normative References

Note: All references in this document to other SMPTE documents may use the current numbering style (e.g. SMPTE ST 125:1995) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 125M-1995). Documents with the same root number (e.g. 125) and publication year (e.g. 1995) are functionally identical.

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 ST 125:1995, Television — Component Video Signal 4:2:2 — Bit-Parallel Digital Interface

SMPTE ST 12-1:2008, Television — Time and Control Code

Recommendation ITU-R BT.601-7 (2011), Studio Encoding Parameters of Digital Television for Standard 4:3 and Wide-Screen 16:9 Aspect Ratios

Recommendation ITU-R BT.656-5 (2007), Interface for Digital Component Video Signals in 525-Line and 625-Line Television Systems Operating at the 4:2:2 Level of Recommendation ITU-R BT.601

4 D-VITC General

4.1 Signal Definition

The D-VITC codeword shall be the VITC codeword as specified by SMPTE ST 12-1, Section 10 (“Vertical Interval Application”).

D-VITC is an 8-bit digital data representation of the VITC codeword which is band-limited to permit a compatible analog conversion to a vertical interval time code (VITC) waveform approximating SMPTE ST 12-1 (see Annex E). The 8 bits of D-VITC shall be carried in the 8 most significant bits of the 10 bits of the SMPTE ST 125 or Recommendation ITU-R BT.601 coding. Since some equipment may be built using only 8 of the 10 bits, both 10- and 8-bit interpretations of the values are given in this standard, with 10 bits the preferred expression and 8 bits given in parentheses.

Note: See Annex D and Annex E for additional information on conversion to and from the analog domain.

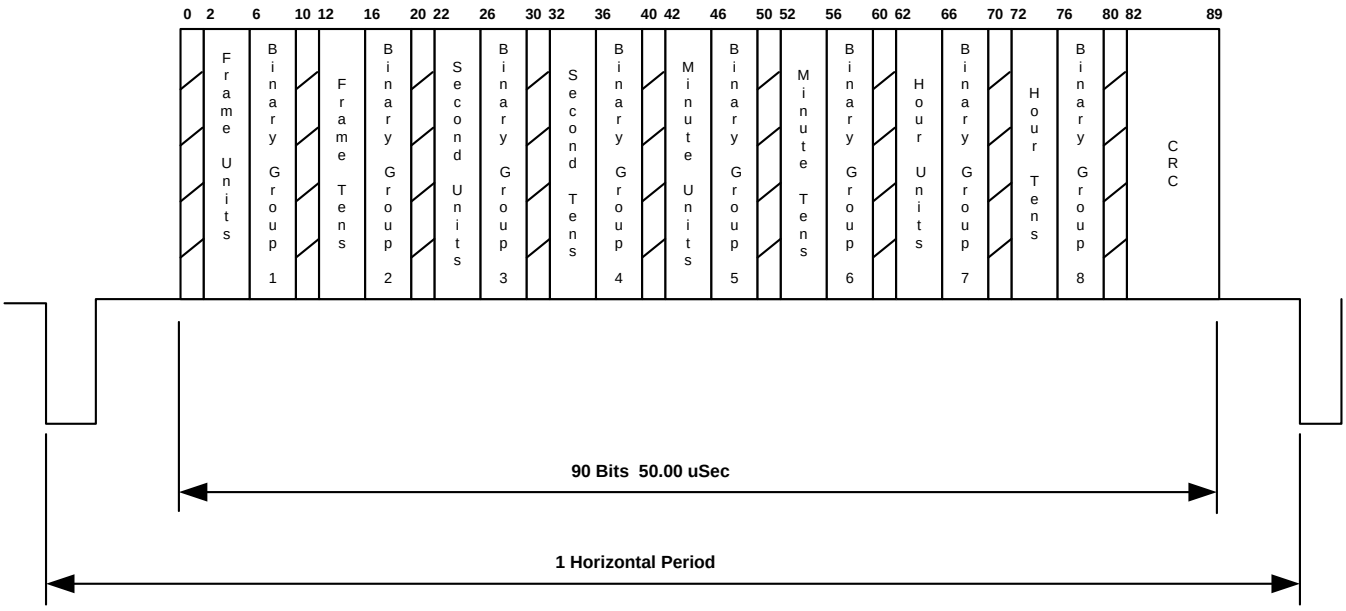
4.2 Data Assignment

The 90 bits of the VITC codeword defined in SMPTE ST 12-1 shall be carried by 675 consecutive luma samples (see figure 1) of the data stream defined in SMPTE ST 125 and Recommendation ITU-R BT.601. Each VITC bit is therefore represented by 7.5 luma samples. The timing of the VITC bits on the digital line shall be as shown in Figure 2. The midpoint of the rise of bit 0 of the VITC codeword shall be coincident with luma sample number 26.

4.3 Transitions

The shape of transitions between VITC bits is defined by the values assigned to luma samples in the transition region. Because the number of luma samples chosen is an odd integer multiple (15) of one-half the total number of VITC bits per line, it is necessary to define two distinct transition data sets (see the lower drawing in Figure 2).

Note: When viewed in the analog domain, the resulting transitions are a close approximation to a raised cosine shape.



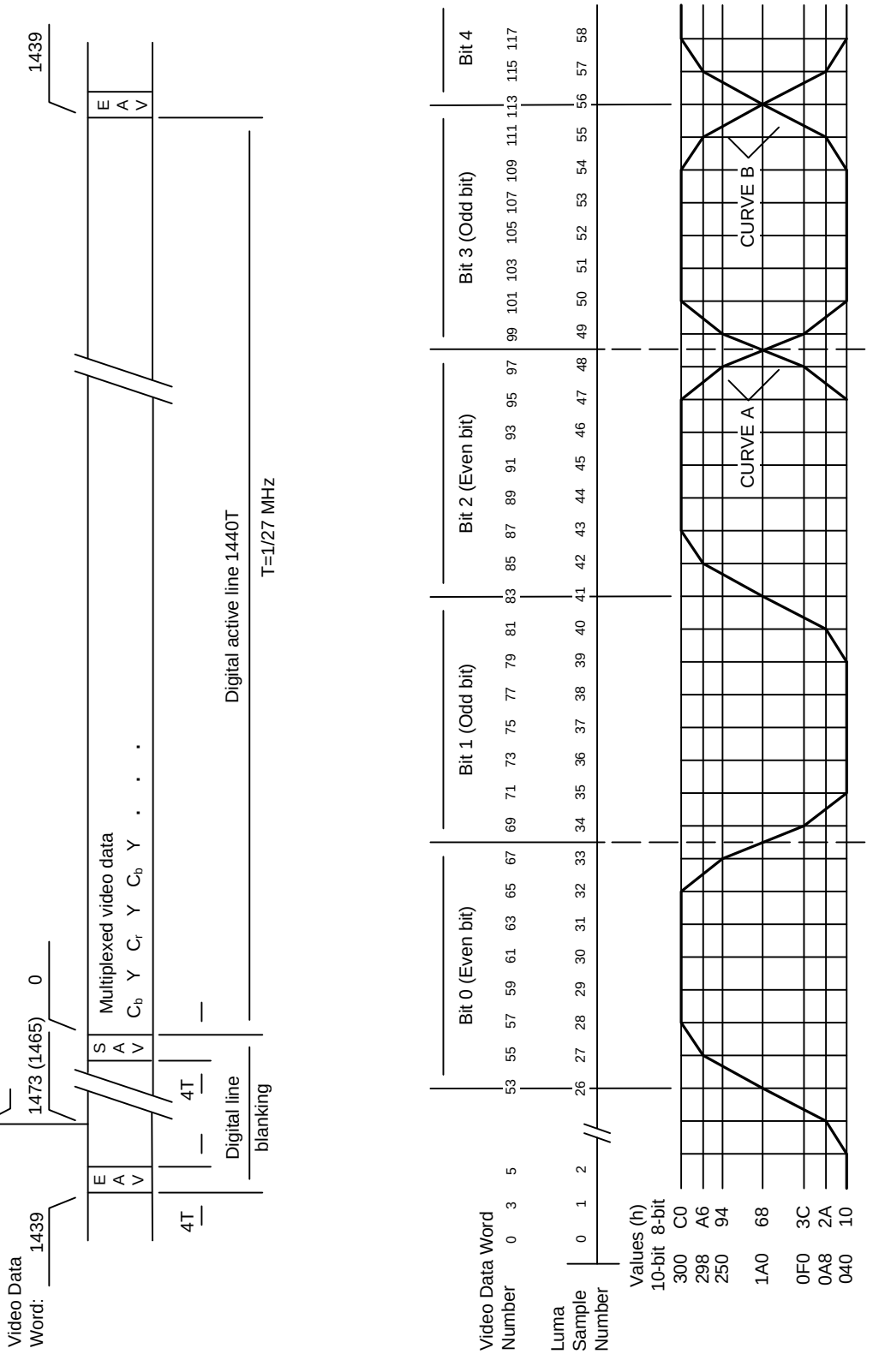
VITC bit no.	Value (weight)	Assigned Use
0	1	VITC SYNC BITS
1	0	
2	(1)	FRAME UNITS
3	(2)	
4	(4)	
5	(8)	
6	(LSB)	FIRST BINARY GROUP
7	|	
8	|	
9	(MSB)	
10	1	VITC SYNC BITS
11	0	
12	(10)	FRAME TENS
13	(20)	
14	FLAG	(See Note 1)
15	FLAG	(See Note 1)
16	(LSB)	SECOND BINARY GROUP
17	|	
18	|	
19	(MSB)	
20	1	VITC SYNC BITS
21	0	
22	(1)	SECOND UNITS
23	(2)	
24	(4)	
25	(8)	
26	(LSB)	THIRD BINARY GROUP
27	|	
28	|	
29	(MSB)	

VITC bit no.	Value (weight)	Assigned Use
30	1	VITC SYNC BITS
31	0	
32	(10)	SECOND TENS
33	(20)	
34	(40)	
35	FLAG	FLAG
36	(LSB)	FOURTH BINARY GROUP
37	|	
38	|	
39	(MSB)	
40	1	VITC SYNC BITS
41	0	
42	(1)	MINUTE UNITS
43	(2)	
44	(4)	
45	(8)	
46	(LSB)	FIFTH BINARY GROUP
47	|	
48	|	
49	(MSB)	
50	1	VITC SYNC BITS
51	0	
52	(10)	MINUTE TENS
53	(20)	
54	(40)	
55	FLAG	(See Note 1)
56	(LSB)	SIXTH BINARY GROUP
57	|	
58	|	
59	(MSB)	

VITC bit no.	Value (weight)	Assigned Use
60	1	VITC SYNC BITS
61	0	
62	(1)	HOUR UNITS
63	(2)	
64	(4)	
65	(8)	
66	(LSB)	SEVENTH BINARY GROUP
67	|	
68	|	
69	(MSB)	
70	1	VITC SYNC BITS
71	0	
72	(10)	HOUR TENS
73	(20)	
74	FLAG	(See Note 1)
75	FLAG	(See Note 1)
76	(LSB)	EIGHTH BINARY GROUP
77	|	
78	|	
79	(MSB)	
80	1	VITC SYNC BITS
81	0	
82-89		VITC CRC CODE

Note 1: Flag bits are as specified by SMPTE ST 12-1.

Figure 1 – SMPTE ST 12-1 VITC bit assignment (Informative)



CURVE A: Transition from even bit to odd bit
CURVE B: Transition from odd bit to even bit

Figure 2 – D-VITC waveform representation and position in digital video samples

4.4 Digital Data

In the following clauses, 10-bit values are given and preferred. Equivalent values for 8-bit representations used in earlier documentation of SMPTE ST 125 are given in parentheses.

4.4.1 Data value associated with a logical one

The data value associated with a logical one shall be 300h (C0h).

4.4.2 Data value associated with a logical zero

The data value associated with a logical zero shall be 040h (10h).

4.4.3 Data value associated with transitions

The data values of samples associated with transitions between VITC logical states shall be as specified in the lower drawing in Figure 2.

4.4.4 Data value associated with unused luma sample positions

The data values of all luma samples of the active line period which are not included in the D-VITC waveform shall be set to 040h (10h).

4.4.5 Data value associated with color difference sample positions

The data values of all color difference samples of the active line period shall be set to 200h (80h).

4.5 Insertion Lines

For 525-line/60-field systems, the D-VITC shall be inserted on lines 14 and 277. Insertion on lines 16 and 279 is optional.

For 625-line/50-field systems, the D-VITC shall be inserted on lines 19 and 332. Insertion on lines 21 and 334 is optional.

Annex A Bibliography (Informative)

Note: All references in this document to other SMPTE documents may use the current numbering style (e.g. SMPTE ST 12-2:2008) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 12-2M-2008). Documents with the same root number (e.g. 12-2) and publication year (e.g. 2008) are functionally identical.

SMPTE ST 12-2:2008, Television — Transmission of Time Code in the Ancillary Data Space

Annex B 525-Line Signals (Informative)

The timing relationship between analog VITC and D-VITC for 525-line, 59.94-Hz field rate signals is given in Figure B.1.

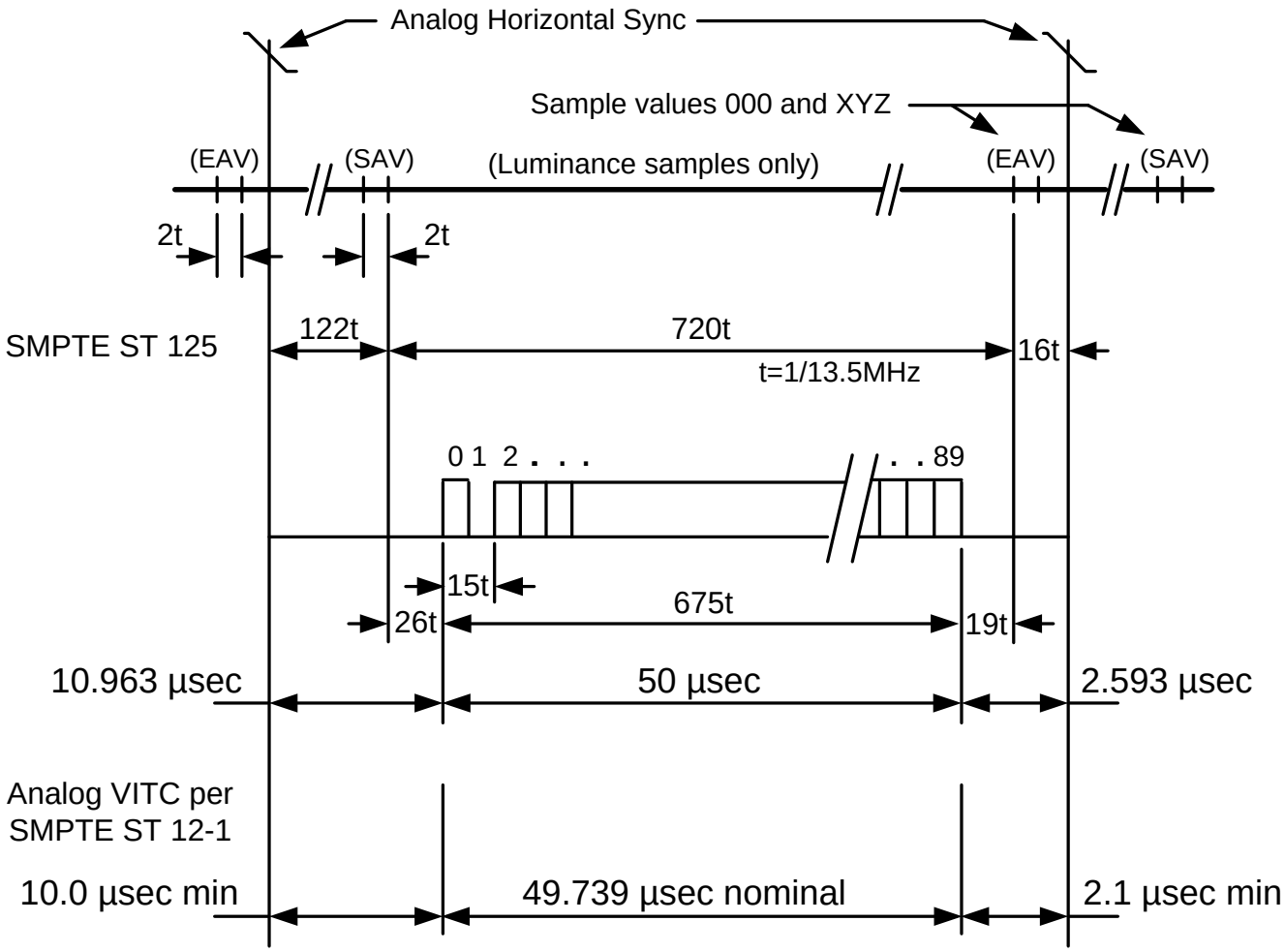


Figure B.1 – Timing relationship between analog VITC and D-VITC for 525/60 standard

Annex C 625-Line Signals (Informative)

The timing relationship between analog VITC and D-VITC for 625-line, 50-Hz field rate signals is given in Figure C.1.

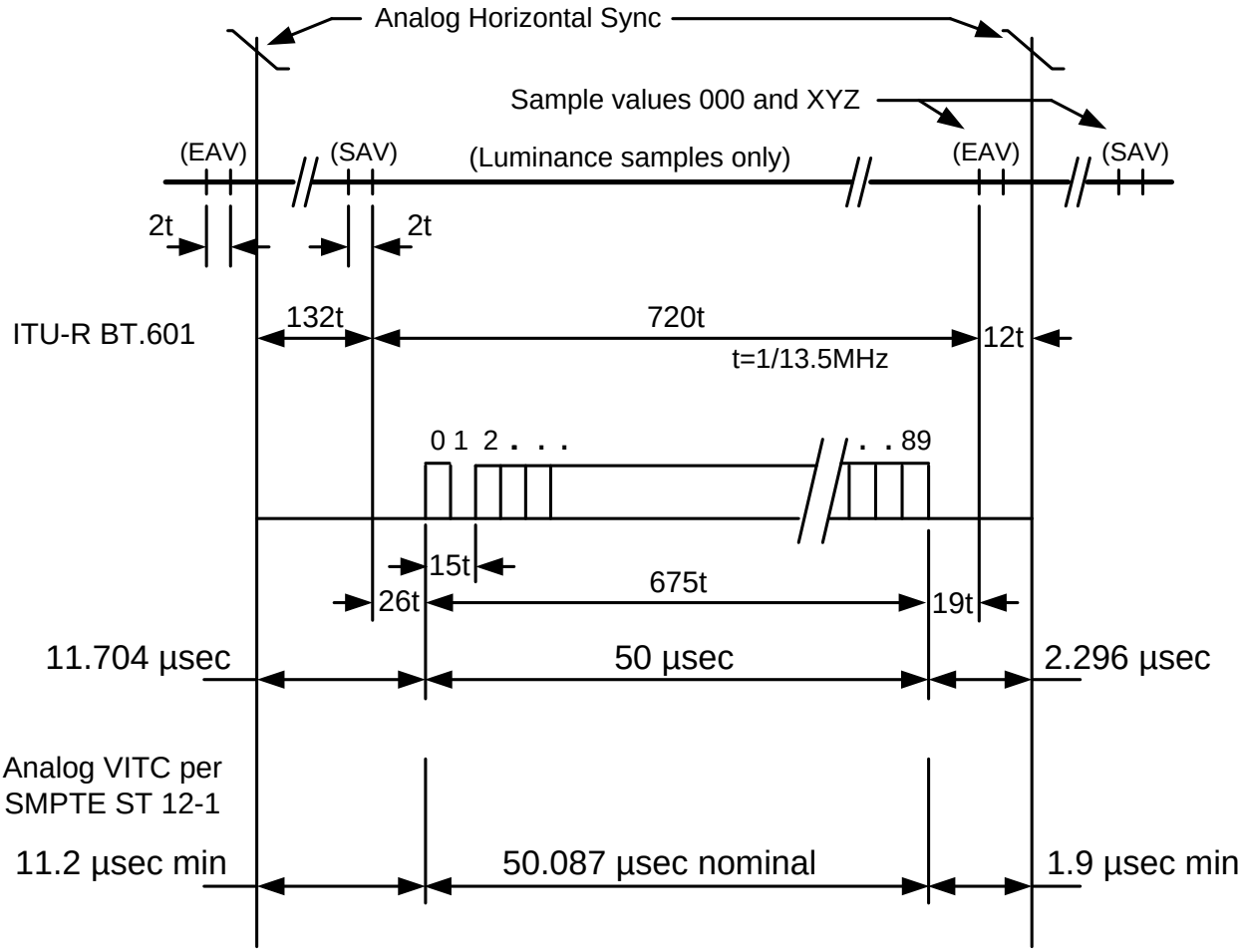


Figure C.1 – Timing relationship between analog VITC and D-VITC for 625/50 standard

Annex D Digital to Analog (D to A) Conversion (Informative)

When D-VITC is D to A converted, the resulting analog signal could deviate from the nominal values given in SMPTE ST 12-1. Table D.1 gives possible deviations. The deviations are a consequence of the use of the 13.5-MHz sampling frequency defined by the 4:2:2 digital data specification of SMPTE ST 125 and Recommendation ITU-R BT.601.

Table D.1 – Tolerance deviations

	VITC		D-VITC	
	SMPTE ST 12-1		SMPTE ST 266	DEVIATION
525-line 60-field systems				
Bit rate [Hz]	1,809,400 ± 2%		1,800,000.0	– 9,400
90-bit duration [µs]	49.739 ± 1		50.0	+ 0.261
625-line 50-field systems				
Bit rate [Hz]	1,796,875 ± 2%		1,800,000.0	+ 3,125
90-bit duration [µs]	50.087 ± 1		50.0	+ 0.067
Bit rate [Hz]			1,800,000.0	– 12,500
90-bit duration [µs]			50.0	+ 0.345

Annex E Analog to Digital (A to D) Conversion (Informative)

Design engineers need to be aware that as a result of wider tolerances of the analog waveform in both amplitude and frequency, the values resulting when an analog VITC signal is A to D converted might differ from the defined digital values given in Figure 2. In addition, the process of Analog to Digital conversion followed by Digital to Analog conversion might result in a VITC signal waveform that deviates from the waveform defined in SMPTE ST 12-1.