SMPTE STANDARD

2048 × 1080 and 4096 × 2160 Digital Cinematography Production Image Formats FS/709

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Approved
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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 2048-1 was prepared by Technology Committee 10E

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 standard defines 2048 × 1080 and 4096 × 2160 image formats primarily for D-Cinema content acquisition and creation. These image formats may also be used for acquisition and creation of high quality content for other D-Cinema applications.

This standard also defines the Color VANC which conveys the parameter values of user-defined color space and Log curve. This standard may be used in the creation of Computer Graphics and other D-Cinema applications related to the pre Digital Cinema Distribution Master (DCDM) creation.

1 Scope

1.1 This standard defines a family of progressive sample structures of 2048 × 1080 and 4096 × 2160 images for D-Cinema content creation as defined in Table 1 and Table 2 in Section 5. This standard specifies:

— R'G'B' color encoding and digital representation[1]

— $Y'C'_BC'_R$ color encoding and digital representation

— $R'_{FS}G'_{FS}B'_{FS}$ color encoding and digital representation

This standard also defines tristimulus values and reference white of Free Scale-Gamut (FS-Gamut), Free Scale-Log (FS-Log) curve and a Color VANC packet. The FS-Log curve has an affinity with the sensitivity of human eye and can specify a much wider dynamic range than the nonlinear curve defined in Recommendation ITU-R BT.709. The Color VANC carries tristimulus values, reference white and parameter values of the FS-Log curve.

An auxiliary component A may optionally accompany R'G'B', $Y'C'_BC'_R$ and $R'_{FS}G'_{FS}B'_{FS}$; these interfaces are denoted R'G'B'A, $Y'C'_BC'_RA$ and $R'_{FS}G'_{FS}B'_{FS}A$. The "A" component if present, shall have the same characteristics as the G', Y' or G'_{FS} channel.

Sampling structures supported by this standard include, 4:4:4:4, 4:4:4, and 4:2:2.

Note: FS-Gamut and FS-Log are identifying names of the defined color space and the Log curve in this standard.

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.

[1] Throughout this standard, references to signals represented by a single primed letter (e.g., R', G', B', Y', C'_B, C'_R and R'_{FS}, G'_{FS}, B'_{FS}) refer to signals to which the transfer characteristics in Section 6 have been applied. Such signals are commonly described as being gamma corrected.

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.

3 Normative References

Note: All references in this document to other SMPTE documents use the current numbering style (e.g. SMPTE ST 274:2008) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 274M-2008). Documents with the same root number (e.g. 274) and publication year (e.g. 2008) 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.

CIE S 014-2/E:2006, Colorimetry Part 2: CIE standard illuminants [ISO 11664-2:2007]

IEEE Std 754-2008, IEEE Standard for Binary Floating-Point Arithmetic

Recommendation ITU-R BT.709-5 (04/02), Parameter Values for the HDTV Standards for Production and International Programme Exchange

SMPTE ST 274:2008, Television — 1920 x 1080 Image Sample Structure, Digital Representation and Digital Timing Reference Sequences for Multiple Picture Rates

SMPTE ST 291:2010, Ancillary Data Packet and Space Formatting

4 General

4.1 An implementation of a system claiming compliance with this standard shall state:

— which of the systems of Table 1 or Table 2 are implemented;

— which of the signal representations are implemented (R'G'B', Y'C'$_B$C'$_R$, R'G'B'A, Y'C'$_B$C'$_R$A, R'$_{FS}$G'$_{FS}$B'$_{FS}$ or R'$_{FS}$G'$_{FS}$B'$_{FS}$ A); and

— whether the digital representation employs 10 bits or 12 bits.

4.2 A 12-bit codeword, when converted to 10 bits, shall either be rounded or truncated. A 10-bit codeword, when converted to a 12-bit codeword, shall have two padding bits added.

4.3 The default values of the color space, reference white are defined in Table 3. Color VANC defined in Section 6.3 shall be used to carry user defined parameters of color primaries and FS-Log curve. ACT1 and ACT2 of the Color VANC indicate active color primaries, active nonlinear curve, active parameters of the FS-Log curve, etc.

5 Image Pixel Array and Mapping

5.1 2048 × 1080 Image Pixel Array

5.1.1 The sampling lattice shall be orthogonal and shall have a pixel aspect ratio of 1:1.

5.1.2 2048 × 1080 systems shall have the maximum number of 2048 horizontal pixels and the maximum number of 1080 vertical pixels per frame.

5.1.3 The data numbering in horizontal pixels shall be from left to right and vertical pixels shall be numbered from top to bottom of the image to be displayed. The data numbering shall begin with 0. The top left sampling data shall be expressed with (0, 0) and the bottom right sampling data shall be (2047, 1079) as shown in Figure 1.

5.1.4 The center of the image shall be located at the center of the 2048 × 1080 pixel array, midway between horizontal pixel number of 1023 and 1024, and midway between vertical pixel number of 539 and 540.

5.1.5 This standard specifies multiple frame rates as shown in Table 1 with pixel depths of 10 bits or 12 bits. It is not necessary for an implementation to support all formats to be compliant with this standard. However, an implementation shall state which of the formats are supported.

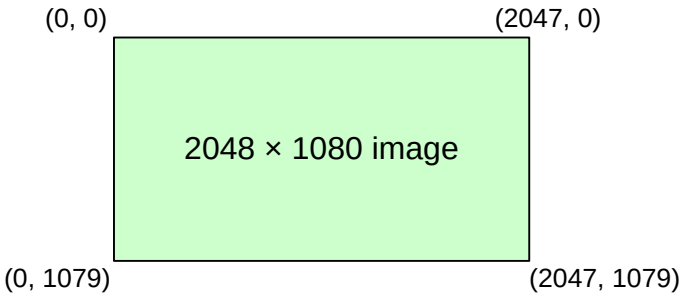


Figure 1 – Horizontal and vertical pixel numbering of 2048 × 1080 progressive images

Table 1 – 2048 × 1080 image pixel array and frame rates

System No.	System nomenclature	Frame rate (Hz)
1	2048 × 1080/60/P	60
2	2048 × 1080/59.94/P	$\frac{60}{1.001}$
3	2048 × 1080/50/P	50
4	2048 × 1080/48/P	48
5	2048 × 1080/47.95/P	$\frac{48}{1.001}$
6	2048 × 1080/30/P	30
7	2048 × 1080/29.97/P	$\frac{30}{1.001}$
8	2048 × 1080/25/P	25
9	2048 × 1080/24/P	24
10	2048 × 1080/23.98/P	$\frac{24}{1.001}$

5.2 4096 × 2160 Image Pixel Array

5.2.1 The sampling lattice shall be orthogonal and shall have a pixel aspect ratio of 1:1.

5.2.2 4096 × 2160 systems shall have maximum number of 4096 horizontal pixels and the maximum number of 2160 vertical pixels per frame.

5.2.3 The data numbering of the horizontal pixels shall be from left to right and vertical pixels shall be numbered from top to bottom of the image. The data numbering shall begin with 0. The top left sampling data shall be expressed with (0, 0) and the bottom right sampling data shall be (4095, 2159) as shown in Figure 2.

5.2.4 The center of the image shall be located at the center of the 4096 × 2160 pixel array, midway between horizontal pixel number of 2047 and 2048, and midway between vertical pixel number of 1079 and 1080.

5.2.5 This standard specifies multiple frame rate formats as shown in Table 2 with pixel depths of 10 bits or 12 bits. It is not necessary for an implementation to support all formats to be compliant with this standard. However, an implementation shall state which of the formats are supported.

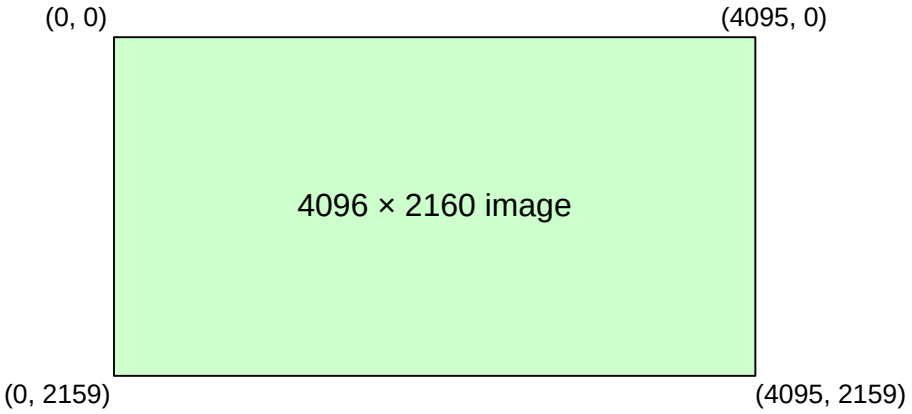


Figure 2 – Horizontal and vertical pixel numbering of 4096 × 2160 images

Table 2 – 4096 × 2160 image pixel array and frame rates

System No.	System nomenclature	Frame rate (Hz)
1	4096 × 2160/60/P	60
2	4096 × 2160/59.94/P	$\frac{60}{1.001}$
3	4096 × 2160/50/P	50
4	4096 × 2160/48/P	48
5	4096 × 2160/47.95/P	$\frac{48}{1.001}$
6	4096 × 2160/30/P	30
7	4096 × 2160/29.97/P	$\frac{30}{1.001}$
8	4096 × 2160/25/P	25
9	4096 × 2160/24/P	24
10	4096 × 2160/23.98/P	$\frac{24}{1.001}$

6 System Colorimetry

6.1 FS Colorimetry

6.1.1 Encoding Primaries Free Scale Gamut (FS-Gamut)

The FS colorimetry shall use the CIE XYZ tristimulus values defined in CIE S 014-2/E [ISO 11664-2] ranging from –2.00000 to +2.00000. Default values of the primaries and reference white shall be as defined in Table 3 and is defined as FS-Gamut.

Table 3 – Default values of FS-Gamut

	CIE *x*	CIE y
R_{FS} primary	0.73470	0.26530
G_{FS} primary	0.14000	0.86000
B_{FS} primary	0.10000	– 0.02985
Reference white D65	0.31272	0.32903

6.1.2 FS-Log curve

From the R_{FS}, G_{FS}, B_{FS} or user defined R_{user}, G_{user}, B_{user} tristimulus values, three nonlinear primary components R'_{FS}, G'_{FS}, B'_{FS} or R', G', B' shall be calculated according to the following FS-Log curve (Equation 1) — and if necessary — the upper and lower three coordinates defined in Table 4. Where nonlinear primary components L' shall be $0 \le L' \le 1$.

Table 4 – Definition of FS-Log curve

Exposure Range	Definition
$L_{C1} \le L \le L_{C3}$	Upper three coordinates (L_{C1}, L'_{C1}), (L_{C2}, L'_{C2}), (L_{C3}, L'_{C3})
$L_{B1} \le L \le L_{C1}$	$L' = \alpha \, \mathrm{Log}_{10} (\beta L + \delta) + \varepsilon$ (Equation 1)
$L_{B3} \le L \le L_{B1}$	Lower three coordinates (L_{B3}, L'_{B3}), (L_{B2}, L'_{B2}), (L_{B1}, L'_{B1})

Where, L shall be a linear tristimulus value multiplied by a k_{exp} factor as shown in Equation 2.

$$L = \text{Linear value} \times k_{exp} \; ; \quad k_{exp} \text{ denotes the exposure value} \qquad \text{(Equation 2)}$$

"a linear value" shall mean that each value be linear relative to the amount of light. For example, G_{FS} = 0.18000 denotes an 18% Gray and G_{FS} = 1.00000 denotes light coming from a 100% reflector. The k_{exp} value shall denote the overexposure and the underexposure, i.e., the k_{exp} value of greater than 1 indicates the overexposure and the k_{exp} value of between 0 and 1 indicates the underexposure. The default value of the k_{exp} shall be 1.00000.

The FS-Log curve shall use the Equation 1 with L from L_{B1} to L_{C1} — and if necessary — in combination with two nonlinear curves connecting the upper three coordinates of (L_{C1}, L'_{C1}), (L_{C2}, L'_{C2}), (L_{C3}, L'_{C3}) with L from L_{C1} to L_{C3} and lower three coordinates of (L_{B1}, L'_{B1}), (L_{B2}, L'_{B2}), (L_{B3}, L'_{B3}) with L from L_{B3} to L_{B1} as shown in Figure 3. L_{B1}, L_{B2}, L_{B3} ($L_{B1} > L_{B2} > L_{B3}$) and L_{C1}, L_{C2}, L_{C3} ($L_{C1} < L_{C2} < L_{C3}$) shall indicate the linear values and L'_{B1}, L'_{B2}, L'_{B3} and L'_{C1}, L'_{C2}, L'_{C3} shall indicate the transformed nonlinear values, respectively.

Each of the two nonlinear curves shall be applied only when Equation 1 can not specify the nonlinear characteristics of primary components and shall be a smooth function connecting each of the upper and lower three coordinates as shown in Figure 4 and Figure 5.

Parameter values of α, β, δ, ε as well as the upper three coordinates of (L_{C1}, L'_{C1}), (L_{C2}, L'_{C2}), (L_{C3}, L'_{C3}) and lower three coordinates of (L_{B1}, L'_{B1}), (L_{B2}, L'_{B2}), (L_{B3}, L'_{B3}) shall be defined within the limitation of having the value of L' ranging from 0 to 1 and shall be carried within the Color VANC defined in Section 6.3.

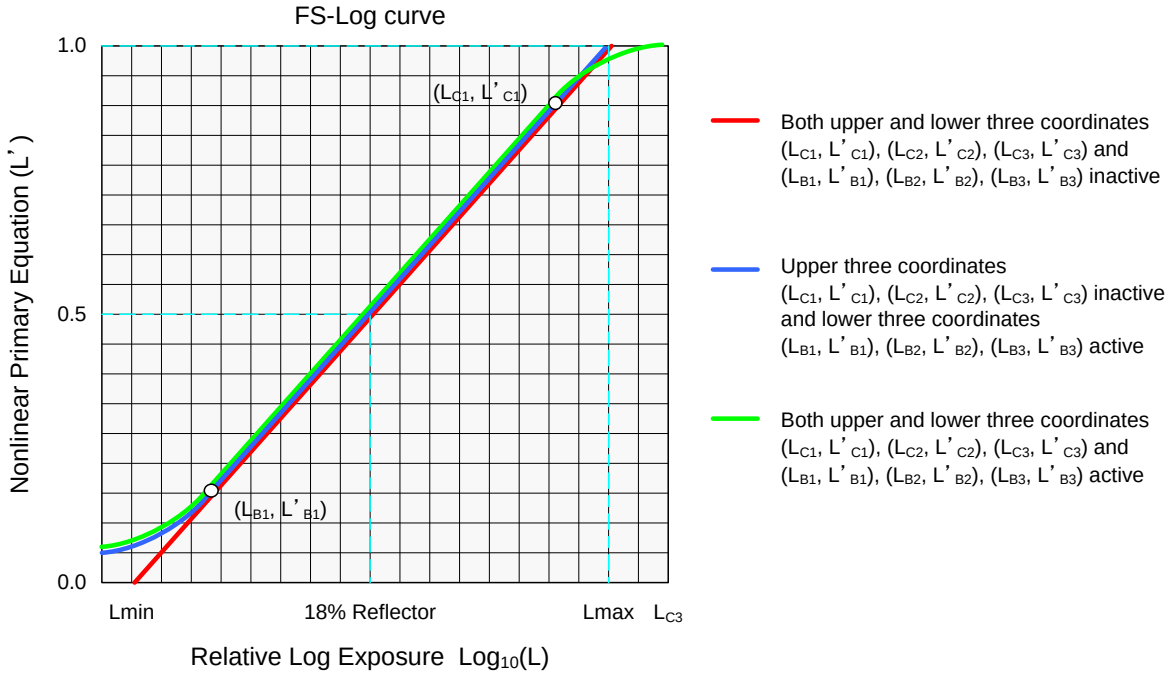


Figure 3 – FS-Log curve

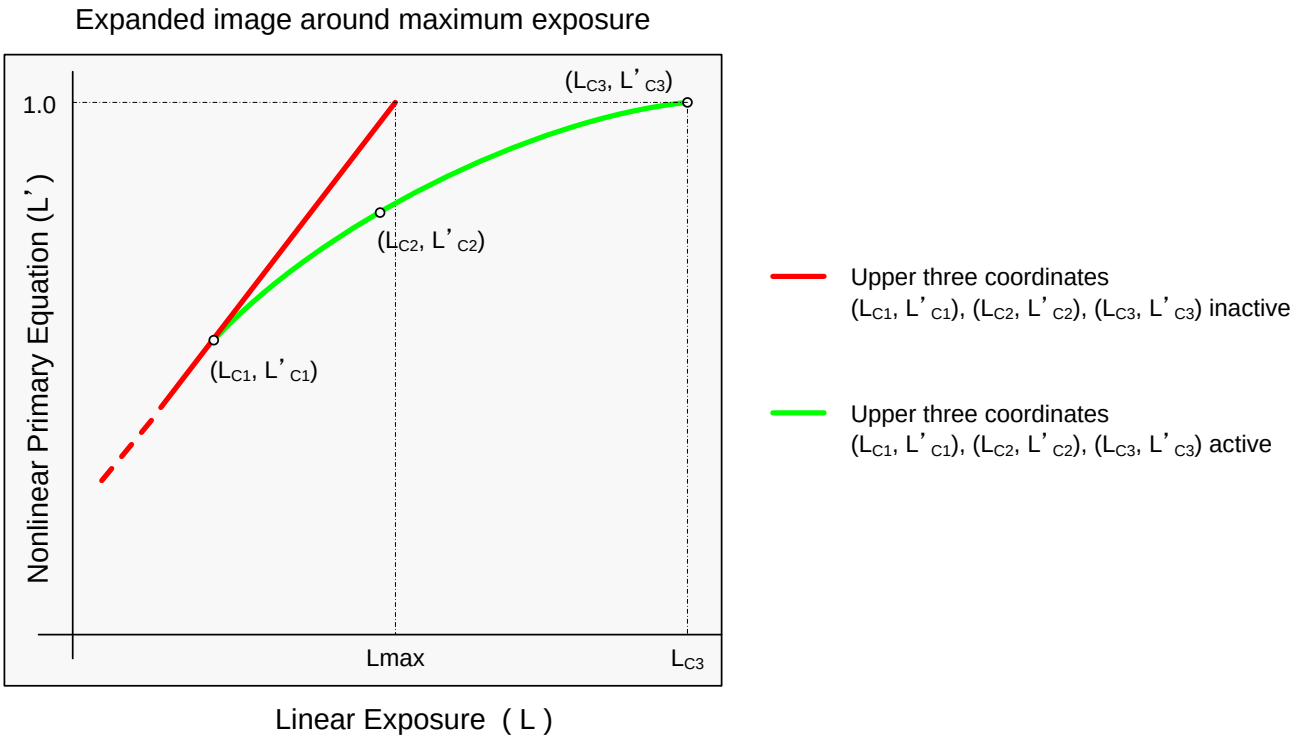


Figure 4 – Three coordinates to define FS-Log curve above L_{C1}

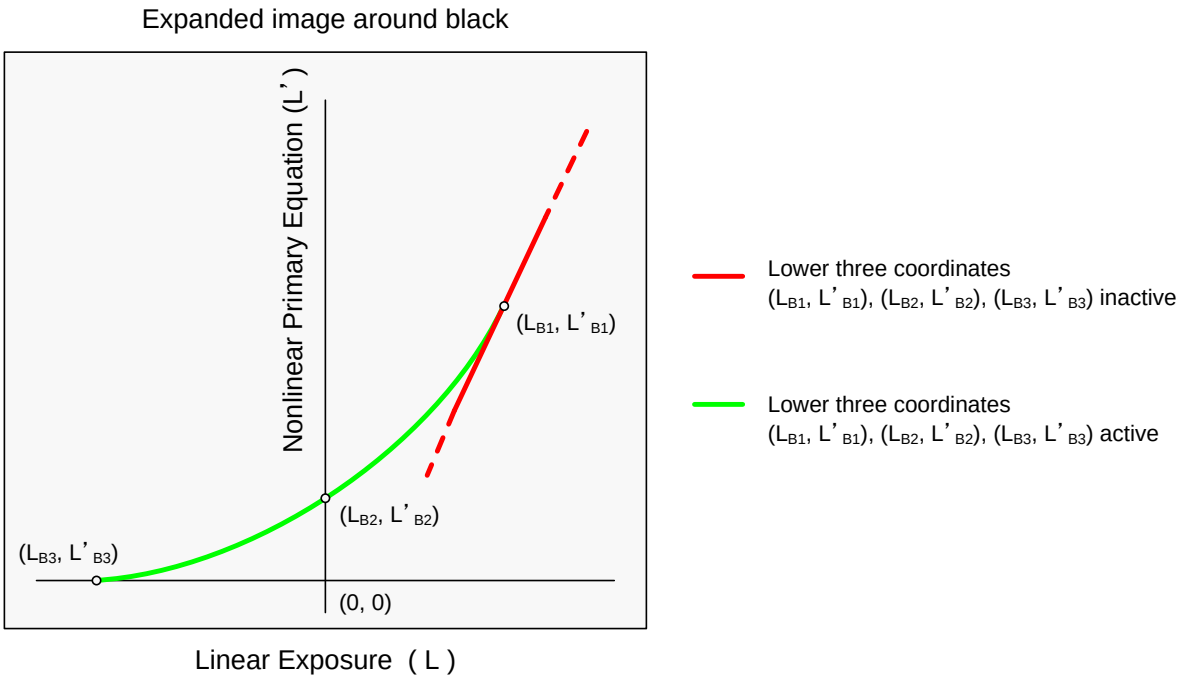


Figure 5 – Three coordinates to define FS-Log curve below L_{B1}

6.1.3 Notation of parameter values

Parameter values which shall be mapped into the Color VANC defined in Section 6.3 shall be denoted by the 32-bit single-precision Binary Floating-Point Arithmetic defined in IEEE Std 754 as shown in Figure 6, and Equation 3.

In Figure 6 and Equation 3, the most significant bit is the sign bit, the exponent is biased by 127(exponent - 127 in the range -126 to +127 are representable), and fraction is significand without the most significant bit. The detail is defined in IEEE Std 754.

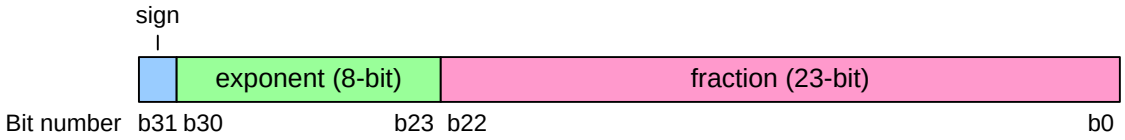


Figure 6 – 32-bit Binary Floating-Point Arithmetic

$$v = s \times 2^{e} \times m$$

or

$$v = (-1)^{sign} \times 2^{(exponent\ -\ 127)} \times 1.fraction \qquad \text{(Equation 3)}$$

Where

s = +1 (positive numbers and +0) when the sign bit is 0

s = −1 (negative numbers and −0) when the sign bit is 1

e = *exponent* − 127 (in other words the exponent is stored with 127 added to it, also called "biased with 127")

m = 1.*fraction* in binary (that is, the significand is the binary number 1 followed by the radix point followed by the bits of the *fraction*). Therefore, 1 < m < 2.

6.2 R'G'B' Colorimetry

The default value of R', G', B' opto-electric conversion including encoding primaries, reference white, opto-electric transfer characteristics as well as Y', C'_B, C'_R computation shall be in conformance with Recommendation ITU-R BT.709-5.

6.3 Color VANC

6.3.1 Structure of Color VANC

The structure of the Color VANC shall be as shown in Figure 7. Color VANC shall be formatted according to the Type 2 requirements of SMPTE 291M and shall include ancillary data flag (ADF), data identification (DID), secondary data identification (SDID), data count (DC), user data words (UDW) and checksum (CS) fields as specified in SMPTE 291M. DC is always 266h. It is suggested that should other gamma values be defined at some point that a separate SDID be used.

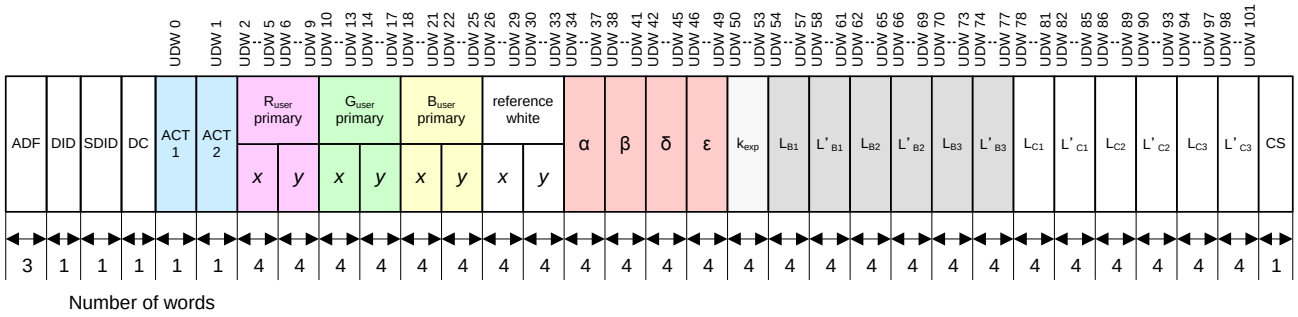


Figure 7 – Structure of Color VANC

6.3.2 The DID value shall be defined as 41_h and the SDID value shall be 02_h.

6.3.3 User data words (UDW) are defined in Section 6.3.4, Section 6.3.5 and Section 6.3.8. In this standard, UDWx shall mean the xth Color VANC word. There shall be always 102 words in the UDW, i.e., UDW0, UDW1…UDW101.

6.3.4 ACT1 to indicate the active color primaries and reference white

The word ACT1 shall indicate, which color primaries and reference white are being defined, i.e., FS-Gamut or the ones defined in Recommendation ITU-R BT.709. The bit assignment of ACT1 shall be as shown in Table 5.

Bits a1.0 or a1.1 shall be set to one for active FS-Gamut or color primaries and reference white defined in Recommendation ITU-R BT.709.

Bits a1.2 through a1.5 shall be set to one, when user defined tristimulus values (R_{user}, G_{user}, B_{user}) and reference white are assigned, and shall be set to zero when default values of (R_{FS}, G_{FS}, B_{FS}) or (R, G, B) primaries and reference white of FS-Gamut or the ones defined in Recommendation ITU-R BT.709 indicated with a1.0 and a1.1 are assigned.

Table 5 – Bit assignment of ACT1

Bit number	CDW0 ACT1
b9 (MSB)	Not b8
b8	Even parity [1)]
b7	Reserved (set to 0)
b6	Reserved (set to 0)
b5	a1.5 active: 1, inactive: 0 (user defined reference white)
b4	a1.4 active: 1, inactive: 0 (user defined B_{user} primary)
b3	a1.3 active: 1, inactive: 0 (user defined G_{user} primary)
b2	a1.2 active: 1, inactive: 0 (user defined R_{user} primary)
b1	a1.1 active: 1, inactive: 0 (Color primaries and white defined in ITU-R BT.709)
b0 (LSB)	a1.0 active: 1, inactive: 0 (FS-Gamut defined in Table 3)

[1)] Even parity for b0 through b7

6.3.5 ACT2 to indicate the active nonlinear equation, active upper or lower three coordinates and the use of default k_{exp} value

The word ACT2 shall indicate which nonlinear equation, i.e., FS-Log curve or the gamma curve defined in Recommendation ITU-R BT.709, shall be used, and whether the upper three coordinates, lower three coordinates and the default value of k_{exp} = 1.00000 shall be used or not. The bit assignment of ACT2 shall be as shown in Table 6.

Bit a2.0 or a2.1 shall be set to one for the active FS-Log curve or the gamma curve defined in Recommendation ITU-R BT.709.

Bits a2.2 and a2.3 shall be set to one for active upper and lower three coordinates. Bit a2.4 shall be set to one, when user defined value of k_{exp} ($\neq$ 1.00000) is assigned and shall be set to zero when default value of k_{exp} = 1.00000 is assigned. Bits a2.2 through a2.4 shall be functional only when a2.0 is set to one, i.e., for active FS-Log curve.

If upper or lower three coordinates are not to be assigned, bit a2.2 or a2.3 shall be set to zero and upper or lower three coordinates values in the Color VANC shall be identified as invalid.

Table 6 – Bit assignment of ACT2

Bit number	CDW1 ACT2
b9 (MSB)	Not b8
b8	Even parity [1)]
b7	Reserved (set to 0)
b6	Reserved (set to 0)
b5	Reserved (set to 0)
b4	a2.4 active: 1, inactive: 0 (user defined k_{exp} ($\neq$ 1.00000))
b3	a2.3 active: 1, inactive: 0 (Lower three coordinates (L_{B1}, L'_{B1}), (L_{B2}, L'_{B2}), (L_{B3}, L'_{B3}))
b2	a2.2 active: 1, inactive: 0 (Upper three coordinates (L_{C1}, L'_{C1}), (L_{C2}, L'_{C2}), (L_{C3}, L'_{C3}))
b1	a2.1 active: 1, inactive: 0 (gamma curve defined in ITU-R BT.709)
b0 (LSB)	a2.0 active: 1, inactive: 0 (FS-Log curve defined in Equation 1 (α, β, δ, ε parameters))

[1)] Even parity for b0 through b7

6.3.6 Color VANC Mapping

The Color VANC packet may be carried when color parameters comply with Recommendation ITU-R BT.709, in all other cases the Color VANC packet shall be carried once per frame. Legacy implementations of the interface may not recognize the Color VANC.

6.3.7 Examples of how to use ACT1 and ACT2

Ex.1) FS-Log curve with upper and lower three coordinates and default tristimulus values, default reference white and default k_{exp}:

	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
ACT1	0	1	0	0	0	0	0	0	0	1
ACT2	0	1	0	0	0	0	1	1	0	1

Parameter values of α, β, δ, ε, upper and lower three coordinates of (L_{C1}, L'_{C1}), (L_{C2}, L'_{C2}), (L_{C3}, L'_{C3}) and (L_{B1}, L'_{B1}), (L_{B2}, L'_{B2}), (L_{B3}, L'_{B3}) shall be mapped into the Color VANC defined in Section 6.3.

Ex.2) FS-Log curve with lower three coordinates and default tristimulus values, default reference white and default k_{exp}:

	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
ACT1	0	1	0	0	0	0	0	0	0	1
ACT2	1	0	0	0	0	0	1	0	0	1

Parameter values of α, β, δ, ε and lower three coordinates of (L_{B1}, L'_{B1}), (L_{B2}, L'_{B2}), (L_{B3}, L'_{B3}) shall be mapped into the Color VANC.

Ex.3) FS-Log curve without upper and lower three coordinates and with user defined tristimulus values, default reference white and over exposure:

	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
ACT1	1	0	0	0	0	1	1	1	0	1
ACT2	1	0	0	0	0	1	0	0	0	1

User defined parameter values of tristimulus values (R_{user}, G_{user}, B_{user}) and α, β, δ, ε, k_{exp} shall be mapped into the Color VANC.

Ex.4) Tristimulus values, reference white and opto-electric conversion defined in Recommendation ITU-R BT.709:

	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
ACT1	0	1	0	0	0	0	0	0	1	0
ACT2	0	1	0	0	0	0	0	0	1	0

In this case, Color VANC need not to be carried.

Ex.5) The gamma curve defined in Recommendation ITU-R BT.709 with user defined tristimulus values and default reference white:

	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
ACT1	1	0	0	0	0	1	1	1	1	0
ACT2	0	1	0	0	0	0	0	0	1	0

User defined tristimulus values of R_{user}, G_{user}, B_{user} shall be mapped into the Color VANC.

6.4.8 R_{FS}, G_{FS}, B_{FS}, Reference White Primaries, α, β, δ, ε, k_{exp} and L_{B1}, L'_{B1}, L_{B2}, L'_{B2}, L_{B3}, L'_{B3}, L_{C1}, L'_{C1}, L_{C2}, L'_{C2}, L_{C3} L'_{C3} parameters

The CIE *x, y* chromaticity coordinates of R_{user}, G_{user}, B_{user} primaries, reference white primaries, parameter values of α, β, δ, ε, k_{exp} and upper and lower three coordinates of L_{B1}, L'_{B1}, L_{B2}, L'_{B2}, L_{B3}, L'_{B3} and L_{C1}, L'_{C1}, L_{C2}, L'_{C2}, L_{C3} L'_{C3} shall be denoted by the 32-bit Binary Floating-Point Arithmetic defined in IEEE 754-2008 as shown in Figure 6. The values of *x*, *y* chromaticity coordinates shall be defined within the range of -2.00000 to +2.00000 i.e.; $-2.00000 \leq x, y \leq +2.00000$.

The bit assignment of R_{user}, G_{user}, B_{user} and the reference white primaries shall be as shown in Table 7 and Table 8. The bit assignment of α, β, δ, ε, k_{exp} and L_{B1}, L'_{B1}, L_{B2}, L'_{B2}, L_{B3}, L'_{B3}, L_{C1}, L'_{C1}, L_{C2}, L'_{C2}, L_{C3}, L'_{C3} shall be as shown in Table 9, Table 10, Table 11 and Table 12, respectively.

Table 7 – Bit-assignment of R_{user}, G_{user}, B_{user} primaries

	Bit number	UDW2	UDW3	UDW4	UDW5
R_{user} primary *x*	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW6	UDW7	UDW8	UDW9
R_{user} primary *y*	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW10	UDW11	UDW12	UDW13
G_{user} primary *x*	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW14	UDW15	UDW16	UDW17
G_{user} primary *y*	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW18	UDW19	UDW20	UDW21
B_{user} primary *x*	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW22	UDW23	UDW24	UDW25
B_{user} primary *y*	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)

[1)] Even parity for b0 through b7

Table 8 – Bit-assignment of reference white primaries

	Bit number	UDW26	UDW27	UDW28	UDW29
reference white *x*	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW30	UDW31	UDW32	UDW33
reference white *y*	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)

[1)] Even parity for b0 through b7

Table 9 – Bit-assignment of α, β, δ, ε parameters

	Bit number	UDW34	UDW35	UDW36	UDW37
α	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW38	UDW39	UDW40	UDW41
β	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW42	UDW43	UDW44	UDW45
δ	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW46	UDW47	UDW48	UDW49
ε	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)

[1)] Even parity for b0 through b7

Table 10 – Bit-assignment of k_{exp}

	Bit number	UDW50	UDW51	UDW52	UDW53
k_{exp}	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)

[1)] Even parity for b0 through b7

Table 11 – Bit-assignment of L_{B1}, L'_{B1}, L_{B2}, L'_{B2}, L_{B3}, L'_{B3}

	Bit number	UDW54	UDW55	UDW56	UDW57
L_{B1}	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW58	UDW59	UDW60	UDW61
L'_{B1}	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW62	UDW63	UDW64	UDW65
L_{B2}	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW66	UDW67	UDW68	UDW69
L'_{B2}	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW70	UDW71	UDW72	UDW73
L_{B3}	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW74	UDW75	UDW76	UDW77
L'_{B3}	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)

[1)] Even parity for b0 through b7

Table 12 – Bit-assignment of L_{C1}, L'_{C1}, L_{C2}, L'_{C2}, L_{C3}, L'_{C3}

	Bit number	UDW78	UDW79	UDW80	UDW81
L_{C1}	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW82	UDW83	UDW84	UDW85
L'_{C1}	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW86	UDW87	UDW88	UDW89
L_{C2}	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW90	UDW91	UDW92	UDW93
L'_{C2}	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW94	UDW95	UDW96	UDW97
L_{C3}	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)
	Bit number	UDW98	UDW99	UDW100	UDW101
L'_{C3}	b9 (MSB)	Not b8	Not b8	Not b8	Not b8
	b8	Even parity [1)]	Even parity [1)]	Even parity [1)]	Even parity [1)]
	b7	b31 (sign)	b23 (exponent)	b15 (fraction)	b7 (fraction)
	b6	b30 (exponent)	b22 (fraction)	b14 (fraction)	b6 (fraction)
	b5	b29 (exponent)	b21 (fraction)	b13 (fraction)	b5 (fraction)
	b4	b28 (exponent)	b20 (fraction)	b12 (fraction)	b4 (fraction)
	b3	b27 (exponent)	b19 (fraction)	b11 (fraction)	b3 (fraction)
	b2	b26 (exponent)	b18 (fraction)	b10 (fraction)	b2 (fraction)
	b1	b25 (exponent)	b17 (fraction)	b9 (fraction)	b1 (fraction)
	b0 (LSB)	b24 (exponent)	b16 (fraction)	b8 (fraction)	b0 (fraction)

[1)] Even parity for b0 through b7

7 Pixel Array Representation

7.1 FS-Log Pixel Array Representation

7.1.1 The FS-Gamut primary components shall be computed according to Equation 4:

$$L'_D = \text{floor}\{(4095/16)DL'\}; \qquad 0 \le L' \le 1,\ D = 2^{n-8}\ n=10, 12 \qquad \text{(Equation 4)}$$

Where L' shall be the component value in abstract terms from 0 to 1, n takes the value 10 or 12 corresponding to the number of bits to be represented, and L'_D is the resulting digital code. The function floor(x) returns the largest integer less than or equal to x.

7.1.2 A system having a 10-bit interface shall address the conversion of 12-bit video data to 10 bits with an appropriate process that minimizes video artifacts such as quantization noise. When converting 10-bit data to 12-bit data, the two least significant bits of the 12-bit word shall be set to 0.

7.2 R'G'B' Pixel Array Representation

The R', G', B' and Y', C'_B, C'_R pixel array representation shall be in conformance with the 10-bit and 12-bit definition in Section 8 of SMPTE ST 274.

Annex A Conversion between FS-Gamut Primaries and ITU-R BT.709, CIE XYZ
(Informative)

The following color space conversion matrixes are derived from using the method provided in Section 4 of SMPTE RP 177.

1. FS-Gamut primaries to ITU-R BT.709 color space

$$\begin{bmatrix} R_{709} \\ G_{709} \\ B_{709} \end{bmatrix} = \begin{bmatrix} 1.8971264766 & -0.7874771526 & -0.1096493239 \\ -0.2061408349 & 1.3399572436 & -0.1338164086 \\ -0.0127365376 & -0.1520554880 & 1.1647920256 \end{bmatrix} \begin{bmatrix} R_{FS} \\ G_{FS} \\ B_{FS} \end{bmatrix}$$

2. ITU-R BT.709 to FS-Gamut primaries

$$\begin{bmatrix} R_{FS} \\ G_{FS} \\ B_{FS} \end{bmatrix} = \begin{bmatrix} 0.5649518215 & 0.3425159210 & 0.0925322576 \\ 0.0886860636 & 0.8099183798 & 0.1013955566 \\ 0.0177548715 & 0.1094744801 & 0.8727706484 \end{bmatrix} \begin{bmatrix} R_{709} \\ G_{709} \\ B_{709} \end{bmatrix}$$

3. FS-Gamut primaries to CIE XYZ color space

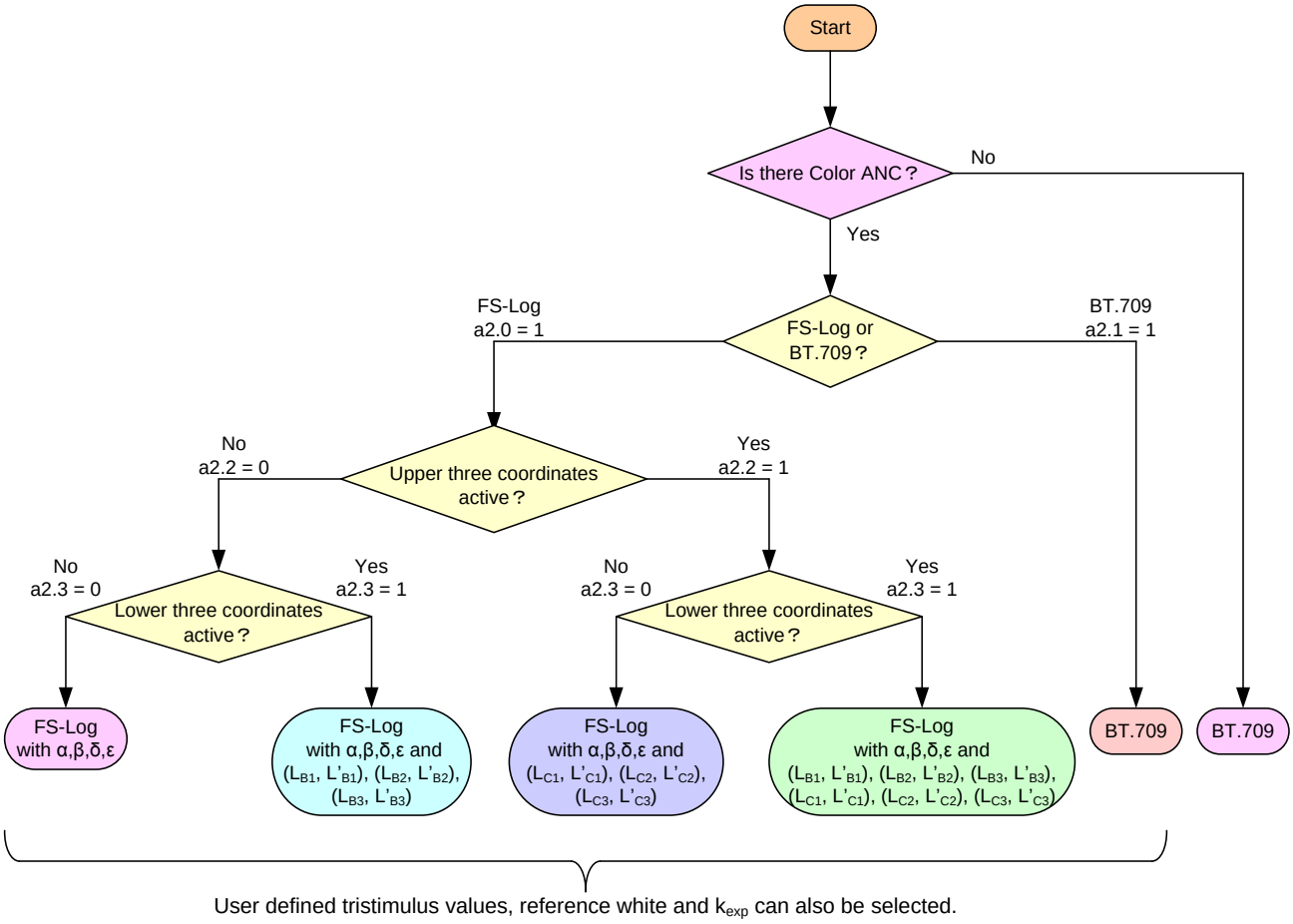
$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 0.7063780094 & 0.1269571894 & 0.1170948531 \\ 0.2550729358 & 0.7798798779 & -0.0349528137 \\ 0.0000000000 & 0.0000000000 & 1.0888064918 \end{bmatrix} \begin{bmatrix} R_{FS} \\ G_{FS} \\ B_{FS} \end{bmatrix}$$

4. CIE XYZ to FS-Gamut primaries

$$\begin{bmatrix} R_{FS} \\ G_{FS} \\ B_{FS} \end{bmatrix} = \begin{bmatrix} 1.5040884699 & -0.2448516114 & -0.1696162473 \\ -0.4919376336 & 1.3623316224 & 0.0966385571 \\ 0.0000000000 & 0.0000000000 & 0.9184368458 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$$

Annex B Flow Chart to Select Nonlinear Curve and Upper and Lower Three Coordinates of FS-Log Curve (Informative)

The flow chart below shows how to select the FS-Log curve or gamma curve defined in BT.709 and active upper and lower three coordinates of FS-Log curve with the use of ACT2 bits.



Annex C Bibliography (Informative)

SMPTE RP 177-1993, Derivation of Basic Television Color Equations

Annex D Document Road Map (Informative)