ARRI LogC4

Logarithmic Color Space

SPECIFICATION

Date: 12th May 2023

Document Version History		
Version	Author(s)	Change Note
2021-07-07	Harald Brendel Sean Cooper	Initial document version
2021-07-22	Sean Cooper	Clarify LogC4 Curve domain
2021-07-28	Sean Cooper	Pseudo-code update
2021-11-30	Sean Cooper	Mirrored LogC4 Curve and sensor-linear definition
2022-05-01	Sean Cooper	Negative handling in LogC4 Curve amended Matrices provided with higher precision Hardware encoding section expanded Reference code provided as CTL
2022-11-08	Sean Cooper	ALEXA 35 added Matrix precision increased CTL Reference amended LogC4 Signal Tables added False Color equations added
2023-05-12	Sean Cooper	Y-Axis tick marks fixed in Figure 2 Expanded False Color computed bounds

Table of Contents

1 Introduction

This document describes the ARRI LogC4 logarithmic color space, hereinafter referred to as ARRI LogC4 or LogC4, and its use.

ARRI LogC4 was designed to optimize the encoding precision and production usability of the increased dynamic range[1] of the ALEV4 sensor. For detailed information about the naming convention and version history of ARRI camera encodings, please see Section 2 and 4.

The development of the transfer function was funded by the Horizon 2020 project HDR4EU[2] .

2 Version History

ARRI LogC4 is a direct successor to the prior LogC v3 encoding definition in use since 2011, and continues its version history. The prefix “ARRI” was adopted to ensure consistent naming across our cameras and provide a stable base for advancement into the future. The following table provides a historical overview of the versioning history for ARRI camera encodings:

ARRI Camera Encoding Version History				
Version	Cameras	SUP Version	Components	Status
1	D-20 D-21	N/A	Log C	Archived
2	ALEXA Classic ALEXA XT ALEXA SXT	SUP 1 SUP 2	ALEXA Log C v2	Archived
3	ALEXA Classic ALEXA XT ALEXA SXT ALEXA Mini ALEXA LF ALEXA Mini LF ALEXA 65 AMIRA	SUP $\geq$ 3	ALEXA LogC v3 ALEXA Wide Gamut RGB ALEXA LogC v3 Curve ——— ARRI LogC3 ARRI Wide Gamut 3 ARRI LogC3 Curve	Active
4	ALEXA 35 …	SUP $\geq$ 1 …	ARRI LogC4 ARRI Wide Gamut 4 ARRI LogC4 Curve	Active

Note: In technical or UI text, the version number must be included for full specificity, including the reduced form, e.g. ARRI LogC4 or LogC4.

[1] Ratio of full well capacity to read out noise
[2] See HDR4EU document D2.5 Real-time HDR to SDR conversion in a generic viewing environment

3 Hardware Encoding

This section outlines the LogC4 Hardware Encoding Curve as used in-camera. The hardware specification is provided as informative material pertaining to sensor signal encoding for LogC4, and is **not** intended to be implemented in software. Please see Section 4 for the specification intended for 3rd Party implementations of ARRI LogC4.

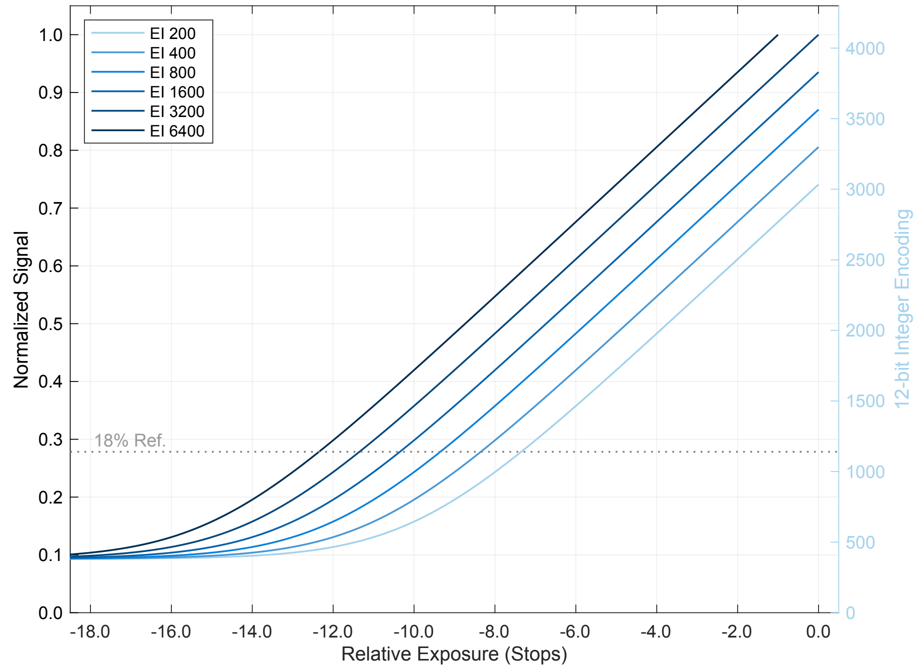

Figure 1: The LogC4 Hardware Encoding Curve at various exposure indices.

3.1 LogC4 Hardware Encoding Curve

The LogC4 Hardware Encoding Curve represents the logarithmic transform applied to linear sensor data in-camera. The most notable change from LogC3 is the constant "gamma" of the logarithmic curve which does not vary with exposure index, only the linear gain factor a_h changes.

The logarithmic encoding used by ALEV4 based cameras for LogC4 was optimized for 12-bit encoding, this allows for greater precision at each stop of sensor signal when compared to the 10-bit LogC3 encoding. The hardware encoding curve is defined as follows:

$$E' = f_{hw}(E_{sensor}, H_{EI}) = min(\frac{log_2(a_h E_{sensor} + 64) - 6}{14} b + c \,, 1.0\,) \tag{1}$$

$$a_h = (2^{18} - 16)\frac{H_{EI}}{800} \tag{1a}$$

$$b = \frac{1023 - 95}{1023} \tag{1b}$$

$$c = \frac{95}{1023} \tag{1c}$$

where:

E_{sensor} = Normalized linear sensor signal.
E' = Normalized log signal.
a_h = Hardware encoding gain factor (EI dependent).
H_{EI} = User selected EI value.
b, c = Scaling and offset, equivalent to LogC3.

4 Specification

This section begins the formal definition of **ARRI LogC4**, the scene-referred logarithmic color space composed of the transfer function **ARRI LogC4 Curve** and the color primaries **ARRI Wide Gamut 4**.

4.1 ARRI LogC4 Curve

ARRI LogC4 Curve (LogC4 Curve) is the transfer function used in ARRI LogC4, it is a scene-referred logarithmic function defined by an encoding and decoding function.

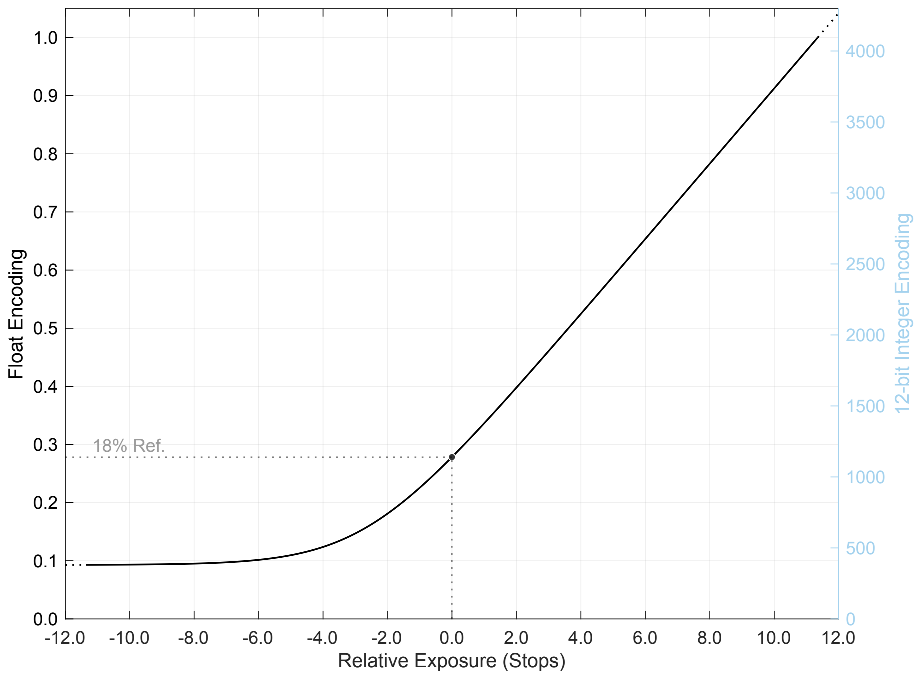

Figure 2: ARRI LogC4 Curve as normalized Float and 12-bit Integer signal.

The ARRI LogC4 Curve is exposure index independent, meaning, correct linearization of LogC4 encoded images does not depend on the user selected EI. This is a notable change from LogC3, and simplifies decoding of LogC4 encoded footage. This feature is enabled by the hardware encoding method described in Section 3.1.

Although ARRI cameras will not produce negative LogC4 values in internal processing or RAW data, negative LogC4 values may be introduced by intermediate processes in post-production software and colorimetric conversions. Negative handling is covered in the following definitions.

Note: The ARRI LogC4 Curve function was designed for 12-bit encoding as its minimum quantization level, 10-bit ARRI LogC4 encoded images should not be used for archival or interchange.

4.1.1 Encoding Function

The function for encoding relative scene linear values is defined as follows:

$$f(E_{scene}) = \begin{cases} \frac{log_2(aE_{scene}+64)-6}{14}b + c & E_{scene} \geq t \\ \frac{E_{scene}-t}{s} & E_{scene} < t \end{cases} \tag{2}$$

$$a = (2^{18} - 16)\frac{1}{117.45} \tag{2a}$$

$$s = \frac{7\ln(2)\ 2^{7-14c/b}}{ab} \tag{2b}$$

$$t = \frac{2^{(14\frac{-c}{b}+6)} - 64}{a} \tag{2c}$$

where:

f = ARRI LogC4 Curve encoding function.
E_{scene} = Relative scene linear signal.
a = Relative scene linear gain factor, see Equation 4.
s = Inverse slope at threshold t.
t = Relative scene linear threshold point.

Terms b and c are defined in Equations 1b, 1c respectively.

4.1.2 Decoding Function

The function for reconstructing relative scene linear values from ARRI LogC4 Curve encoded material, is defined as follows:

$$f^{-1}(E') = \begin{cases} \frac{2^{(14\frac{E'-c}{b}+6)}-64}{a} & E' \geq 0 \\ E's + t & E' < 0 \end{cases} \tag{3}$$

where:

f^{-1} = ARRI LogC4 Curve decoding function.
E' = ARRI LogC4 Curve encoded signal.

Terms a, b, c, s and t are defined in Equations 2a, 1b, 1c, 2b, 2c respectively.

The constant 117.45 found in the parameter a defined in Equation 2a is the relative scene linear gain factor derived by the following equation:

$$117.45 = 0.18/(400/260991) = Scene_{ref.}/(Signal_{ref.}/Signal_{max}) \tag{4}$$

The rounded version, as defined, should be used in all cases.

4.2 ARRI Wide Gamut 4

ARRI Wide Gamut 4 (AWG4) is the name of the color primaries used in ARRI LogC4. All chromaticity values are defined with CIE 1931 2 Degree Standard Observer Colorimetry.

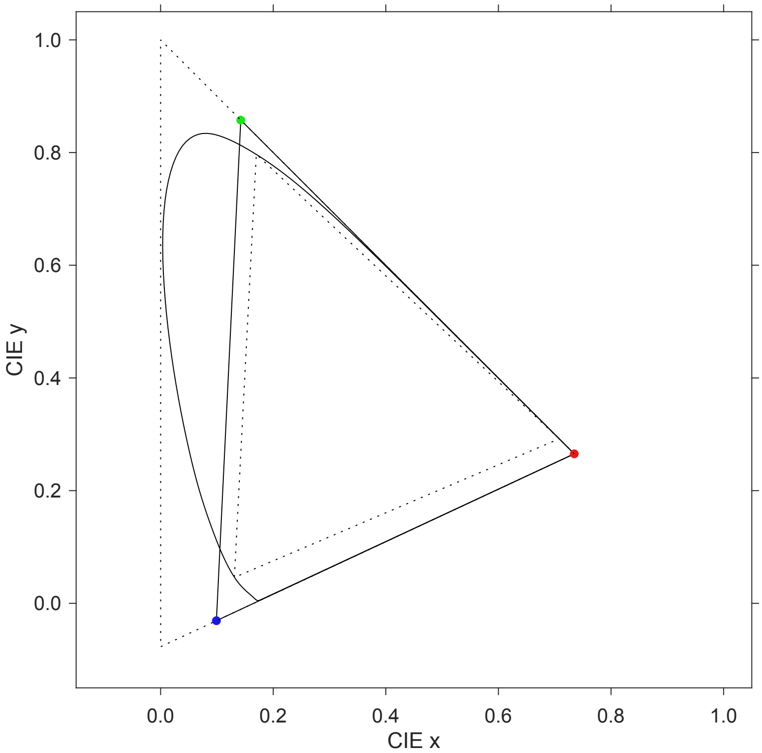

Figure 3: The 2D gamut bounded by ARRI Wide Gamut 4 in the CIE 1931 chromaticity diagram is shown as the solid line with colored markers. The larger and smaller gamuts with dotted lines are ACES AP0 (SMPTE ST 2065-1) and ITU-R BT.2020 respectively.

4.2.1 RGB Primaries

The RGB primaries of ARRI Wide Gamut 4, are defined as follows:

	CIE x	**CIE y**
Red	0.7347	0.2653
Green	0.1424	0.8576
Blue	0.0991	-0.0308

4.2.2 White Point

The White Point of ARRI Wide Gamut 4 is CIE Standard Illuminant D65, provided here for completeness:

	CIE x	**CIE y**
White	0.3127	0.3290

4.3 ARRI LogC4

ARRI LogC4 (LogC4) shall be defined as the logarithmic color space composed of the transfer function ARRI LogC4 Curve and the color primaries ARRI Wide Gamut 4.

4.3.1 ARRI LogC4 to CIE XYZ Conversion

The conversion from ARRI LogC4 to CIE 1931 XYZ is defined as follows:

$$XYZ_{D65} = M_{XYZ} \cdot f^{-1}(RGB_{LogC4}) \tag{5}$$

$$M_{XYZ} = \begin{bmatrix} 0.704858320407232064 & 0.129760295170463003 & 0.115837311473976537 \\ 0.254524176404027025 & 0.781477732712002049 & -0.036001909116029039 \\ 0.000000000000000000 & 0.000000000000000000 & 1.089057750759878429 \end{bmatrix} \tag{5a}$$

where:

f^{-1} = ARRI LogC4 Curve decoding function, defined in Equation 3.
M_{XYZ} = ARRI Wide Gamut 4 to CIE XYZ conversion matrix.

4.3.2 ARRI LogC4 to ACES Conversion

The conversion from ARRI LogC4 to AP0 (SMPTE ST 2065-1) is defined as follows:

$$RGB_{ACES} = M_{ACES} \cdot f^{-1}(RGB_{LogC4}) \tag{6}$$

$$M_{ACES} = \begin{bmatrix} 0.750957362824734131 & 0.144422786709757084 & 0.104619850465508965 \\ 0.000821837079380207 & 1.007397584885003194 & -0.008219421964383583 \\ -0.000499952143533471 & -0.000854177231436971 & 1.001354129374970370 \end{bmatrix} \tag{6a}$$

where:

f^{-1} = ARRI LogC4 Curve decoding function, defined in Equation 3.
M_{ACES} = ARRI Wide Gamut 4 to ACES AP0 conversion matrix.

Note: The above M_{ACES} matrix has been created with a CAT02 chromatic adaptation transform from CIE D65 to the ACES RGB White Point. Which, despite the primaries being defined within the gamut of AP0, may produce negative values at the extreme border of ARRI Wide Gamut 4 in an ACES (ST 2065-1) container. Care should be used to preserve these values if a lossless round-trip conversion is required.

5 Contact

In case you have questions or comments, please contact: arriraw-dev@arri.de

Appendices

A Reference CTL Implementation

```

// Constants
const float a = (pow(2.0, 18.0) - 16.0) / 117.45;
const float b = (1023.0 - 95.0) / 1023.0;
const float c = 95.0 / 1023.0;
const float s = (7 * log(2) * pow(2.0, 7 - 14 * c / b)) / (a * b);
const float t = (pow(2.0, 14.0 * (-c / b) + 6.0) - 64.0) / a;

// Utility function for log2
float log2(float x)
{
  return log(x) / log(2.0);
}

// LogC4 Curve Encoding Function
float relativeSceneLinearToNormalizedLogC4( float x) {

    if (x < t) {
        return (x - t) / s;
    }

    return (log2( a * x + 64.0) - 6.0) / 14.0 * b + c;
}

// LogC4 Curve Decoding Function
float normalizedLogC4ToRelativeSceneLinear( float x) {

    if (x < 0.0) {
        return x * s + t;
    }

    float p = 14.0 * (x - c) / b + 6.0;
    return (pow(2.0, p) - 64.0) / a;
}

void logC4ToACES
( input varying float rIn,
  input varying float gIn,
  input varying float bIn,
  input varying float aIn,
  output varying float rOut,
  output varying float gOut,
  output varying float bOut,
  output varying float aOut)
{

    float r_lin = normalizedLogC4ToRelativeSceneLinear(rIn);
    float g_lin = normalizedLogC4ToRelativeSceneLinear(gIn);
    float b_lin = normalizedLogC4ToRelativeSceneLinear(bIn);

    // Matrix AWG4 + D65 --CAT02--> ACES AP0 + ACES RGB White Point
    rOut = r_lin *  0.750957362824734131 + g_lin *  0.144422786709757084 + b_lin * 0.104619850465508965;
    gOut = r_lin *  0.000821837079380207 + g_lin *  1.007397584885003194 + b_lin * -0.008219421964383583;
    bOut = r_lin * -0.000499952143533471 + g_lin * -0.000854177231436971 + b_lin * 1.001354129374970370;
    aOut = 1.0;

}
```

B Conversion Table - ARRI LogC4 to ACES 2065-1

Description	**ARRI LogC4 (R, G, B)**	**ACES 2065-1 (R, G, B)**
Relative Scene Linear 0.0	0.0929, 0.0929, 0.0929	0.0000, 0.0000, 0.0000
Relative Scene Linear 0.18	0.2784, 0.2784, 0.2784	0.1800, 0.1800, 0.1800
LogC4 0.0	0.0000, 0.0000, 0.0000	-0.0181, -0.0181, -0.0181
ARRI LogC4 Hardware Max	1.0000, 1.0000, 1.0000	469.80, 469.80, 469.80

C Conversion Table - ARRI LogC4 Signal (1% IRE)

10-bit Legal	12-bit Legal	10-bit Full	12-bit Full	IRE	Stops
145	581	95	380	9.29%	BLACK
152	606	102	410	10.00%	-6.31
160	641	113	450	11.00%	-4.96
169	676	123	491	12.00%	-4.22
178	712	133	532	13.00%	-3.69
187	747	143	573	14.00%	-3.26
195	782	153	614	15.00%	-2.90
204	817	164	655	16.00%	-2.58
213	852	174	696	17.00%	-2.29
222	887	184	737	18.00%	-2.03
230	922	194	778	19.00%	-1.78
239	957	205	819	20.00%	-1.55
248	992	215	860	21.00%	-1.33
257	1027	225	901	22.00%	-1.12
265	1062	235	942	23.00%	-0.91
274	1097	246	983	24.00%	-0.71
283	1132	256	1024	25.00%	-0.52
292	1167	266	1065	26.00%	-0.33
301	1202	276	1106	27.00%	-0.15
308	1232	285	1140	27.84%	0.00
309	1237	286	1147	28.00%	0.03
318	1272	297	1188	29.00%	0.21
327	1307	307	1229	30.00%	0.38
336	1342	317	1269	31.00%	0.55
344	1377	327	1310	32.00%	0.72
353	1412	338	1351	33.00%	0.89
362	1447	348	1392	34.00%	1.06
371	1482	358	1433	35.00%	1.22
379	1517	368	1474	36.00%	1.39
388	1552	379	1515	37.00%	1.55
397	1588	389	1556	38.00%	1.71
406	1623	399	1597	39.00%	1.87
414	1658	409	1638	40.00%	2.03
423	1693	419	1679	41.00%	2.19
432	1728	430	1720	42.00%	2.35
441	1763	440	1761	43.00%	2.51
449	1798	450	1802	44.00%	2.67
458	1833	460	1843	45.00%	2.83
467	1868	471	1884	46.00%	2.99
476	1903	481	1925	47.00%	3.14
484	1938	491	1966	48.00%	3.30
493	1973	501	2007	49.00%	3.46
502	2008	512	2048	50.00%	3.61
511	2043	522	2088	51.00%	3.77
520	2078	532	2129	52.00%	3.93
528	2113	542	2170	53.00%	4.08
537	2148	552	2211	54.00%	4.24
546	2183	563	2252	55.00%	4.39
555	2218	573	2293	56.00%	4.55
563	2253	583	2334	57.00%	4.70
572	2288	593	2375	58.00%	4.86
581	2323	604	2416	59.00%	5.02
590	2358	614	2457	60.00%	5.17
598	2393	624	2498	61.00%	5.33
607	2428	634	2539	62.00%	5.48
616	2464	644	2580	63.00%	5.64
625	2499	655	2621	64.00%	5.79
633	2534	665	2662	65.00%	5.94
642	2569	675	2703	66.00%	6.10
651	2604	685	2744	67.00%	6.25
660	2639	696	2785	68.00%	6.41
668	2674	706	2826	69.00%	6.56
677	2709	716	2867	70.00%	6.72
686	2744	726	2907	71.00%	6.87
695	2779	737	2948	72.00%	7.03
703	2814	747	2989	73.00%	7.18
712	2849	757	3030	74.00%	7.34
721	2884	767	3071	75.00%	7.49
730	2919	777	3112	76.00%	7.64
739	2954	788	3153	77.00%	7.80
747	2989	798	3194	78.00%	7.95
756	3024	808	3235	79.00%	8.11
765	3059	818	3276	80.00%	8.26
774	3094	829	3317	81.00%	8.42
782	3129	839	3358	82.00%	8.57
791	3164	849	3399	83.00%	8.73
800	3199	859	3440	84.00%	8.88
809	3234	870	3481	85.00%	9.03
817	3269	880	3522	86.00%	9.19
826	3304	890	3563	87.00%	9.34
835	3340	900	3604	88.00%	9.50
844	3375	910	3645	89.00%	9.65
852	3410	921	3686	90.00%	9.81
861	3445	931	3726	91.00%	9.96
870	3480	941	3767	92.00%	10.12
879	3515	951	3808	93.00%	10.27
887	3550	962	3849	94.00%	10.42
896	3585	972	3890	95.00%	10.58
905	3620	982	3931	96.00%	10.73
914	3655	992	3972	97.00%	10.89
922	3690	1003	4013	98.00%	11.04
931	3725	1013	4054	99.00%	11.20
940	3760	1023	4095	100.00%	11.35

D Conversion Table - ARRI LogC4 Signal (1/3 Stops)

10-bit Legal	12-bit Legal	10-bit Full	12-bit Full	IRE	Stops
151	606	102	409	9.99%	-6 1/3
153	612	104	416	10.16%	-6
155	620	106	425	10.38%	-5 2/3
157	629	109	436	10.64%	-5 1/3
160	640	112	449	10.96%	-5
163	654	116	465	11.35%	-4 2/3
168	670	121	484	11.82%	-4 1/3
172	690	127	507	12.38%	-4
178	713	133	534	13.04%	-3 2/3
185	740	141	566	13.81%	-3 1/3
193	771	150	602	14.70%	-3
202	807	161	643	15.71%	-2 2/3
212	846	172	690	16.85%	-2 1/3
223	891	185	742	18.11%	-2
235	939	199	798	19.49%	-1 2/3
248	991	215	859	20.97%	-1 1/3
262	1047	231	924	22.56%	-1
276	1106	248	993	24.25%	- 2/3
292	1167	266	1065	26.01%	- 1/3
308	1232	285	1140	27.84%	0
324	1298	304	1217	29.73%	1/3
341	1366	324	1297	31.67%	2/3
359	1435	344	1378	33.65%	1
376	1506	365	1461	35.67%	1 1/3
394	1578	386	1544	37.72%	1 2/3
412	1650	407	1629	39.78%	2
431	1723	428	1714	41.87%	2 1/3
449	1797	450	1800	43.97%	2 2/3
468	1871	471	1887	46.08%	3
486	1945	493	1974	48.20%	3 1/3
505	2020	515	2061	50.33%	3 2/3
524	2095	537	2149	52.47%	4
542	2170	559	2236	54.61%	4 1/3
561	2245	581	2324	56.75%	4 2/3
580	2320	603	2412	58.90%	5
599	2395	625	2500	61.05%	5 1/3
618	2471	647	2588	63.21%	5 2/3
637	2546	669	2676	65.36%	6
655	2622	691	2765	67.51%	6 1/3
674	2697	713	2853	69.67%	6 2/3
693	2773	735	2941	71.83%	7
712	2848	757	3030	73.98%	7 1/3
731	2924	779	3118	76.14%	7 2/3
750	3000	801	3206	78.30%	8
769	3075	823	3295	80.46%	8 1/3
788	3151	845	3383	82.62%	8 2/3
807	3227	867	3472	84.78%	9
826	3302	889	3560	86.94%	9 1/3
844	3378	911	3648	89.10%	9 2/3
863	3454	934	3737	91.26%	10
882	3529	956	3825	93.41%	10 1/3
901	3605	978	3914	95.57%	10 2/3
920	3681	1000	4002	97.73%	11
939	3756	1022	4091	99.89%	11 1/3

E False Color

False Color is defined as a collection of False Color Zones with upper and lower bounds, within which the image signal is replaced with a constant color to visualize important exposure information. The bounds of the False Color Zones are defined with respect to normalized sensor linear values (E_{sensor}) and applied on achromatic normalized LogC4 encoded values (A'). Thus a two step process is required to calculate the input *RGB*$_{LogC4}$ values that should be colored in the False Color overlay.

E.1 Achromatic Calculation

First an achromatic signal is calculated from the three channel *RGB*$_{LogC4}$ signal.

$$A' = 0.21260E'_r + 0.71520E'_g + 0.07220E'_b \tag{7}$$

where:

A' = Achromatic LogC4 signal.
E'_r = Red channel of the normalized *RGB*$_{LogC4}$ signal.
E'_g = Green channel of the normalized *RGB*$_{LogC4}$ signal.
E'_b = Blue channel of the normalized *RGB*$_{LogC4}$ signal.

E.2 False Color Zones

The LogC4 encoded False Color Zone bounds are split into two types, EI dependent and EI independent. EI dependent zones include those which visualize sensor noise or clipping behaviour which scale with the EI gain. Whereas EI independent zones are fixed relative to absolute sensor signal and calculated at a fixed EI of 400. To determine the active zone region, the Lower Bound value is inclusive and the Upper Bound value is exclusive.

Color	Description	Lower Bound (E_{sensor})	Upper Bound (E_{sensor})
Red	1/3 stop below clipping	207149	—
Yellow	2/3 stops below clipping	164414	207149
Blue	Edge of shadow detail	3	12
Purple	Noise floor	—	3

Table 1: EI Dependent False Color Zones (F_D)

Color	Description	Lower Bound (E_{sensor})	Upper Bound (E_{sensor})
Pink	1 stop above 18% middle grey	1440	1760
Green	18% middle grey	720	880

Table 2: EI Independent False Color Zones (F_I)

The LogC4 encoded False Color Zone bounds can then be determined by using the previously defined LogC4 Hardware Encoding Curve formulas, as follows:

$$B_z = f_{hw}(\frac{F_D}{N}, H_{EI}) \tag{8a}$$

$$B_z = f_{hw}(\frac{F_I}{N}, 400) \tag{8b}$$

$$N = 260991 \tag{8c}$$

where:

B_z = Normalized LogC4 Curve encoded bound for zone z. $B_z \in \{B_{z_l}, B_{zu}\}$
f_{hw} = LogC4 Hardware Encoding Curve function, defined in Equation 1.
F_D = *Upper* or *Lower Bound* of EI dependent False Color Zone (Table 1).
N= Max signal normalization factor.
H_{EI} = User selected EI value.
F_I = *Upper* or *Lower Bound* of EI independent False Color Zone (Table 2).

Note: The two undefined upper and lower bounds for the signal extrema are respectively fixed at the min and max of the output signal A', *i.e.* for the Red Upper Bound $B_{zu} = 1.0$ and for the Purple Lower Bound $B_{z_l} = 0.0$ for all EI.

Note: For $H_{EI} \geq 3200$, the top two zone's bounds (Red, Yellow) are held at a constant EI 3200. This is due to this EI gain producing values beyond 1.0 in LogC4. This results in the visualization of earlier signal clipping than what is present in the sensor linear values or RAW file.

E.3 False Color Calculation

$$(R, G, B) = \begin{cases} (R_z, G_z, B_z) & B_{z_l} \leq A' < B_{zu} \\ (A', A', A') & \textit{otherwise} \end{cases} \tag{9}$$

where:

B_{z_l} = Lower bound for a particular zone z. Calculated from Equations 8a, 8b, 8c.
B_{zu} = Upper bound for a particular zone z. Calculated from Equations 8a, 8b, 8c.
R_z = Red value from the corresponding False Color Zone Index.
G_z = Green value from the corresponding False Color Zone Index.
B_z = Blue value from the corresponding False Color Zone Index.
A' = Achromatic LogC4 signal.
(R, G, B) = Output display RGB signal.

E.3.1 False Color Zone Color Index

Color	Description	(R_z, G_z, B_z)
Red	1/3 stop below clipping	(1.0, 0.0, 0.0)
Yellow	2/3 stops below clipping	(1.0, 1.0, 0.0)
Pink	1 stop above 18% middle grey	(1.0, 0.7, 0.7)
Green	18% middle grey	(0.0, 1.0, 0.0)
Blue	Edge of shadow detail	(0.0, 0.0, 1.0)
Purple	Noise floor	(0.7, 0.0, 1.0)

Table 3: The False Color Index colors have no colorimetric meaning and are purely categorical.

E.3.2 Computed Bounds – EI 160

Color	Description	Lower Bound (12-bit)	Upper Bound (12-bit)
Red	1/3 stop below clipping	2860	4095
Yellow	2/3 stops below clipping	2772	2860
Pink	1 stop above 18% middle grey	1341	1412
Green	18% middle grey	1106	1172
Blue	Edge of shadow detail	384	394
Purple	Noise floor	0	384

Table 4: EI 160 LogC4 Encoded False Color Zones

E.3.3 Computed Bounds – EI 200

Color	Description	Lower Bound (12-bit)	Upper Bound (12-bit)
Red	1/3 stop below clipping	2946	4095
Yellow	2/3 stops below clipping	2857	2946
Pink	1 stop above 18% middle grey	1341	1412
Green	18% middle grey	1106	1172
Blue	Edge of shadow detail	385	398
Purple	Noise floor	0	385

Table 5: EI 200 LogC4 Encoded False Color Zones

E.3.4 Computed Bounds – EI 250

Color	Description	Lower Bound (12-bit)	Upper Bound (12-bit)
Red	1/3 stop below clipping	3031	4095
Yellow	2/3 stops below clipping	2943	3031
Pink	1 stop above 18% middle grey	1341	1412
Green	18% middle grey	1106	1172
Blue	Edge of shadow detail	386	402
Purple	Noise floor	0	386

Table 6: EI 250 LogC4 Encoded False Color Zones

E.3.5 Computed Bounds – EI 320

Color	Description	Lower Bound (12-bit)	Upper Bound (12-bit)
Red	1/3 stop below clipping	3125	4095
Yellow	2/3 stops below clipping	3037	3125
Pink	1 stop above 18% middle grey	1341	1412
Green	18% middle grey	1106	1172
Blue	Edge of shadow detail	387	408
Purple	Noise floor	0	387

Table 7: EI 320 LogC4 Encoded False Color Zones

E.3.6 Computed Bounds – EI 400

Color	Description	Lower Bound (12-bit)	Upper Bound (12-bit)
Red	1/3 stop below clipping	3211	4095
Yellow	2/3 stops below clipping	3122	3211
Pink	1 stop above 18% middle grey	1341	1412
Green	18% middle grey	1106	1172
Blue	Edge of shadow detail	389	415
Purple	Noise floor	0	389

Table 8: EI 400 LogC4 Encoded False Color Zones

E.3.7 Computed Bounds – EI 500

Color	Description	Lower Bound (12-bit)	Upper Bound (12-bit)
Red	1/3 stop below clipping	3296	4095
Yellow	2/3 stops below clipping	3208	3296
Pink	1 stop above 18% middle grey	1341	1412
Green	18% middle grey	1106	1172
Blue	Edge of shadow detail	391	423
Purple	Noise floor	0	391

Table 9: EI 500 LogC4 Encoded False Color Zones

E.3.8 Computed Bounds – EI 640

Color	Description	Lower Bound (12-bit)	Upper Bound (12-bit)
Red	1/3 stop below clipping	3391	4095
Yellow	2/3 stops below clipping	3302	3391
Pink	1 stop above 18% middle grey	1341	1412
Green	18% middle grey	1106	1172
Blue	Edge of shadow detail	394	434
Purple	Noise floor	0	394

Table 10: EI 640 LogC4 Encoded False Color Zones

E.3.9 Computed Bounds – EI 800

Color	Description	Lower Bound (12-bit)	Upper Bound (12-bit)
Red	1/3 stop below clipping	3476	4095
Yellow	2/3 stops below clipping	3388	3476
Pink	1 stop above 18% middle grey	1341	1412
Green	18% middle grey	1106	1172
Blue	Edge of shadow detail	398	446
Purple	Noise floor	0	398

Table 11: EI 800 LogC4 Encoded False Color Zones

E.3.10 Computed Bounds – EI 1000

Color	Description	Lower Bound (12-bit)	Upper Bound (12-bit)
Red	1/3 stop below clipping	3561	4095
Yellow	2/3 stops below clipping	3473	3561
Pink	1 stop above 18% middle grey	1341	1412
Green	18% middle grey	1106	1172
Blue	Edge of shadow detail	402	461
Purple	Noise floor	0	402

Table 12: EI 1000 LogC4 Encoded False Color Zones

E.3.11 Computed Bounds – EI 1280

Color	Description	Lower Bound (12-bit)	Upper Bound (12-bit)
Red	1/3 stop below clipping	3656	4095
Yellow	2/3 stops below clipping	3567	3656
Pink	1 stop above 18% middle grey	1341	1412
Green	18% middle grey	1106	1172
Blue	Edge of shadow detail	408	481
Purple	Noise floor	0	408

Table 13: EI 1280 LogC4 Encoded False Color Zones

E.3.12 Computed Bounds – EI 1600

Color	Description	Lower Bound (12-bit)	Upper Bound (12-bit)
Red	1/3 stop below clipping	3741	4095
Yellow	2/3 stops below clipping	3653	3741
Pink	1 stop above 18% middle grey	1341	1412
Green	18% middle grey	1106	1172
Blue	Edge of shadow detail	415	503
Purple	Noise floor	0	415

Table 14: EI 1600 LogC4 Encoded False Color Zones

E.3.13 Computed Bounds – EI 2000

Color	Description	Lower Bound (12-bit)	Upper Bound (12-bit)
Red	1/3 stop below clipping	3827	4095
Yellow	2/3 stops below clipping	3738	3827
Pink	1 stop above 18% middle grey	1341	1412
Green	18% middle grey	1106	1172
Blue	Edge of shadow detail	423	528
Purple	Noise floor	0	423

Table 15: EI 2000 LogC4 Encoded False Color Zones

E.3.14 Computed Bounds – EI 2560

Color	Description	Lower Bound (12-bit)	Upper Bound (12-bit)
Red	1/3 stop below clipping	3921	4095
Yellow	2/3 stops below clipping	3833	3921
Pink	1 stop above 18% middle grey	1341	1412
Green	18% middle grey	1106	1172
Blue	Edge of shadow detail	434	561
Purple	Noise floor	0	434

Table 16: EI 2560 LogC4 Encoded False Color Zones

E.3.15 Computed Bounds – EI 3200

Color	Description	Lower Bound (12-bit)	Upper Bound (12-bit)
Red	1/3 stop below clipping	4007	4095
Yellow	2/3 stops below clipping	3918	4007
Pink	1 stop above 18% middle grey	1341	1412
Green	18% middle grey	1106	1172
Blue	Edge of shadow detail	446	595
Purple	Noise floor	0	446

Table 17: EI 3200 LogC4 Encoded False Color Zones