White Paper on D-Log and D-Gamut

of

DJI Cinema Color System

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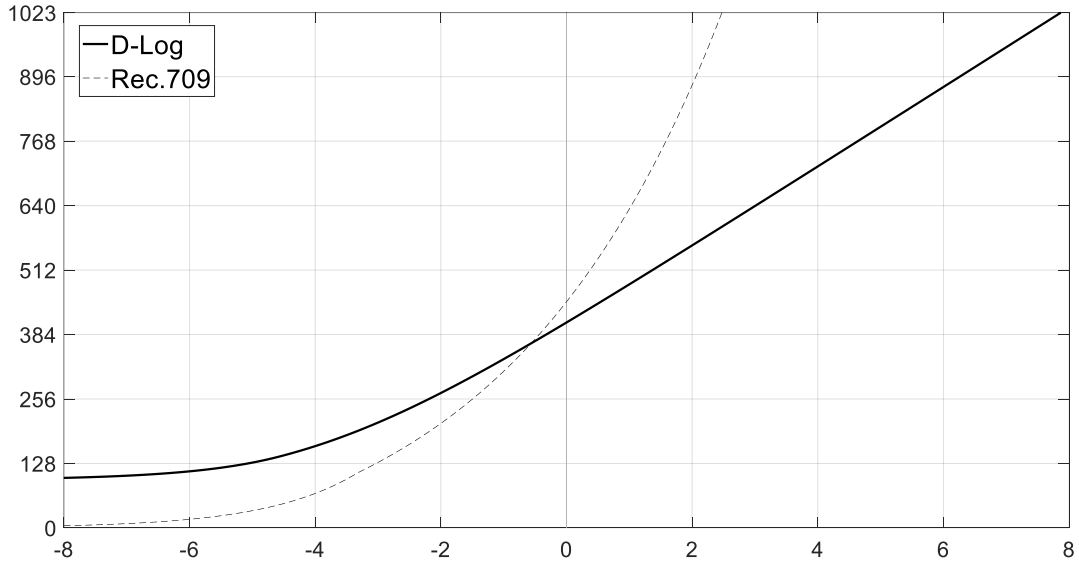
THE FUTURE OF POSSIBLE

This document provides technical information on DJI's gamma curve (D-Log) and gamut (D-Gamut) of DJI Cinema Color System.

D-Log is designed based on opto-electric conversion function characteristics of negative film scan, to be compatible with conventional film workflow.
It covers roughly 15 f-stops' dynamic range, which is adequate for main stream cinema use while keeping noise acceptable.
The following graph shows D-Log gamma in a log-linear plot:



Exposure (f-stops)

0 stands for 18% mid gray

The function for conversion from linear signal to D-Log data is:

in <= 0.0078

out = 6.025 * in + 0.0929;

in > 0.0078

out = (log10(in * 0.9892 + 0.0108)) * 0.256663 + 0.584555;

The reverse conversion (from D-Log data to linear signal) is:

in <= 0.14

out = (x - 0.0929) / 6.025;

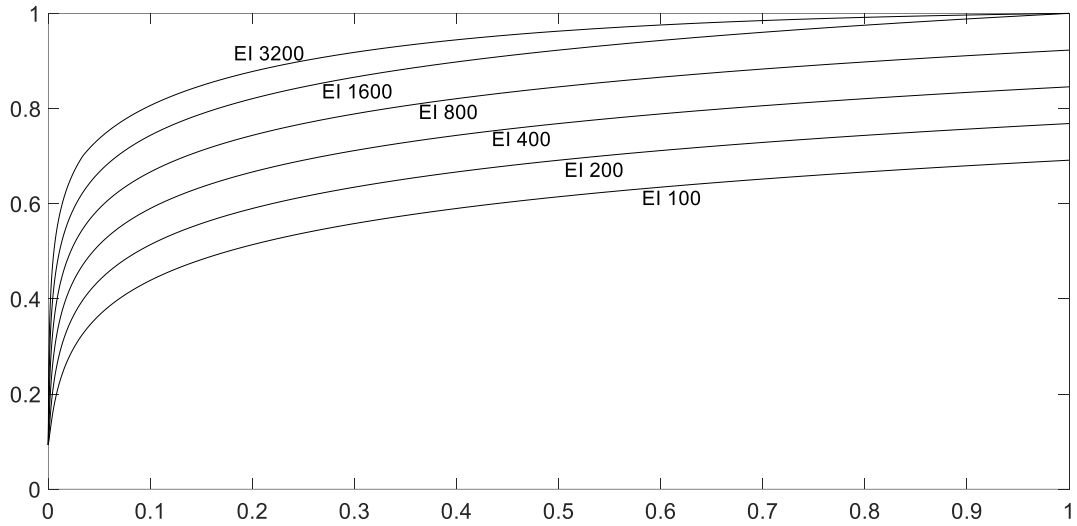
in > 0.14

out = (10^(3.89616 * x - 2.27752) - 0.0108)/0.9892;

The following table shows characteristics of D-Log curve:

Input reflection (%)	10bit code value
0	95
18	408
90	586

The D-Log curve encodes 7.8 stops above 18% gray (4200%) to 1.0.
The D-Log curve's EI value is measured as 1600 on DJI Zenmuse X5S. It is scaled to generate a set of log curves for different exposure indices, as shown in the following figure:



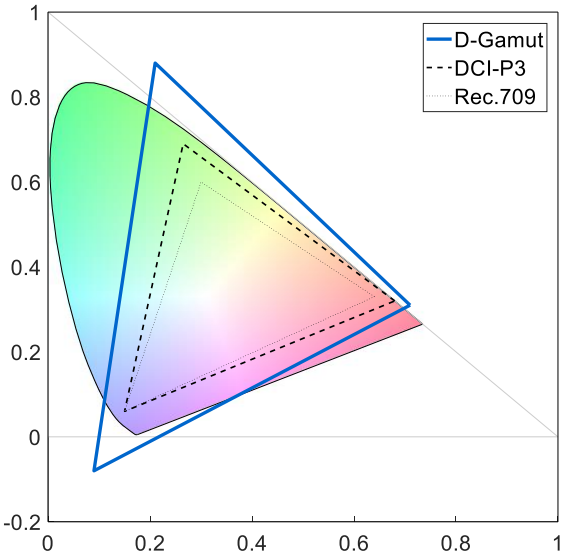
D-Log curves for different exposure indices.
X-axis is the normalized signal of the image sensor.

The maximum value of the curve depends on the EI value. When EI value is below 1600, the output code value will not reach saturation level (e.g. 1023 for 10bit). This is the necessary compromise to achieve better signal-noise-ratio.
For EI above 1600, the output code value will be beyond saturation level if calculated by the linear-log conversion function, thus an s-shape function is applied to keep output code value in valid range.

D-Gamut is designed to fully utilize capability of DJI Zenmuse camera's image sensor and at the same time to provide optimal start point for grading.
D-Gamut fully covers ITU-R Rec. 709 and DCI-P3. It has a margin over DCI-P3 so is capable

for grading and archiving in cinema use. The RGB primaries of D-Gamut is designed in the way that red, green, blue primaries of D-Gamut are respectively aligned with red, green, blue primaries of DCI-P3 and white point (D65) in a line as much as possible. The benefit is that hue remain mostly unchanged during color space conversion when gamut mapping occurs. For users there are two important advantages: Firstly, manual grading is much easier because contrast and saturation are relatively easier to tune than hue. Secondly, footages before grading have right color so log preview is more meaningful.

The following graph and table show D-Gamut and its RGB primaries. The white point is defined as D65.



	x	y
R	0.71	0.31
G	0.21	0.88
B	0.09	−0.08
White (D65)	0.3127	0.3290

The D-Gamut RGB to CIE 1931 XYZ conversion matrix is shown below.

0.6482	0.1940	0.1082
0.2830	0.8132	-0.0962
-0.0183	-0.0832	1.1903

The CIE 1931 XYZ to D-Gamut RGB conversion matrix is shown below.

1.7257	-0.4314	-0.1917
-0.6025	1.3906	0.1671
-0.0156	0.0905	0.8489

The D-Gamut RGB to ITU Rec. 709 RGB conversion matrix is shown below.

1.6746	-0.5797	-0.0949
-0.0981	1.3340	-0.2359
-0.0410	-0.2430	1.2840

The ITU Rec. 709 RGB to D-Gamut RGB conversion matrix is shown below.

0.6163	0.2857	0.0980
0.0505	0.7990	0.1505
0.0292	0.1604	0.8104