

CaIMAN Setup Guide

Color Volume Analysis Workflow

Rev. 1.2

Introduction

Until the introduction of HDR, a video display's color reproduction range was typically represented with a two-dimensional chromaticity diagram such as the 1931 or 1976 CIE chromaticity diagram. A triangle overlaid on the chromaticity diagram indicated the bounds of the color gamut reproduced by a given device or specified by a particular color standard.

However, a color gamut triangle on a 2D chromaticity diagram represents a display's range of colors at only one luminance level, typically 75% of the display's peak luminance. As the luminance of any color decreases toward black or increases toward white, the saturation of the color decreases. Thus, at lower and higher luminance levels, the range (gamut) of colors produced by a display decreases; the gamut triangle gets smaller.

Adding luminance levels to the 2D color gamut diagram results in a 3-dimensional color volume that represents the combined ranges of hue, saturation, and luminance that a display can produce.

The CalMAN Color Volume Analysis workflow provides two different metrics to analyze the volume of a display's color reproduction range, CIE L*a*b* and ICtCp.

The CIE L*a*b* Color Volume metric measures 140 points and calculates the CIE L* a*b* volume as a percentage of BT.709, DCI-P3, and BT.2020. There is also a *Relative* or *Absolute* calculation selection in the workflow page.

The ICtCp Color Volume metric measures 393 point on the gamut shell and calculates how many Millions of Distinguishable Colors (MDC) the display can reproduce.

Color Volume Metric Selection

The opening page of the Color Volume Analysis workflow provides selection buttons for the two color volume analysis metrics.

Click one of the following links to jump in this document to a guide for the desired CalMAN color volume analysis metric.

[CIE L*a*b* Color Volume](#)

[ICtCp Color Volume](#)

CIE L*a*b* Color Volume

The CIE L*a*b* Color Volume metric measures 140 points and calculates the CIE L* a*b* volume as a percentage of BT.709, DCI-P3, and BT.2020. There is also a *Relative* or *Absolute* calculation selection in the workflow page.

Jump to [ICtCp Color Volume](#)

Hardware Connect page

Meter

1. Connect your meter to the computer, and then connect CalMAN to the meter.
2. Select the *Meter Mode* that most closely corresponds to the backlight technology for your target display type.

Source

1. Connect your HDR10-compatible test pattern source to the computer and then connect CalMAN to the source. Enable HDR10 on the *Source Settings* tab and select a 1 second source delay.
2. Select the "Window 4-40" pattern window size, if it is available. Otherwise, select the default "Window 10%" pattern window size.

Pattern Insertion page

Depending on the display technology you are measuring (LCD or OLED) and the test pattern you selected above, you will need to enable "Full Field Pattern Insertion" (FFPI). In the CalMAN *Settings* menu (gear wheel), under *Application Measurement Options*, configure FFPI as shown below.

LCD Window 10% pattern: FFPI Settings - Frequency: 1, Duration: 2, Level: 0%

LCD Window 4-40 pattern: FFPI Disabled

OLED Window 10% pattern: FFPI Settings - Frequency: 30, Duration: 4, Level: 10%

OLED Window 4-40 pattern: FFPI Settings - Frequency: 30, Duration: 4, Level: 10%

L*a*b* Color Volume page

Setup

For *Peak Luminance Target*, select 540, 1000, 1500, 2000, 4000, or 10,000 nits if you want to compare the display to a theoretical display of a certain peak luminance.

Otherwise, select “Relative” to compare the display to a theoretical display with the same peak luminance of the display you are measuring.

The number of total measurement points will be indicated.

Results

The results of the CIE L*a*b* Color Volume analysis are shown in terms of the percentage of the calculated color volume to the BT.709, DCI-P3, and BT.2020 color volumes.

Color Volume Visualizer

When the CIE L*a*b* Color Volume measurement is complete, you can export the measurement data and view it in the *Color Volume Visualizer* application. Currently, the *Color Volume Visualizer* is compatible only with the “Relative” CIE L*a*b* measurement type.

To view the measured color volume:

1. At the bottom of the *CIE L*a*b* Color Volume* page (Figure 2), click the *Export Data* button.
2. Edit the name of the file, if desired, and save the .csv file to a convenient directory location.
3. Click the *Download App* button to download the Color Volume Visualizer.exe file. Copy the executable file to a convenient location.
4. Run the *Color Volume Visualizer.exe* file.

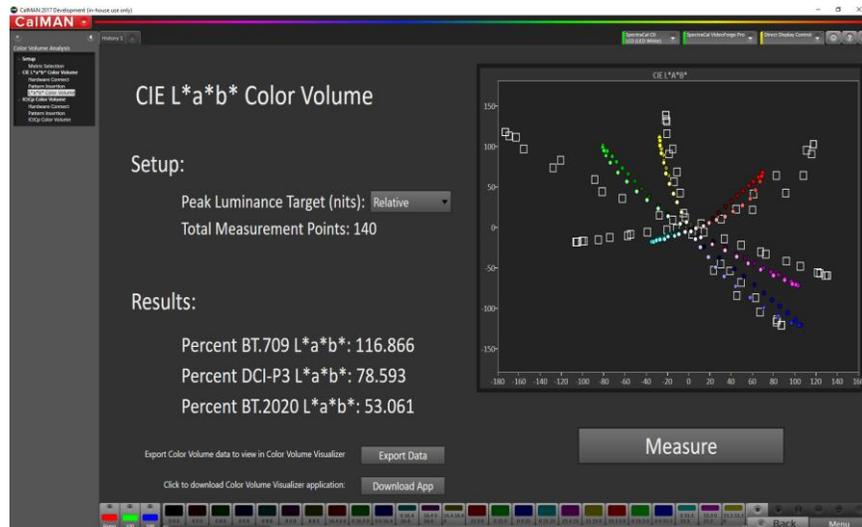


Figure 2. CIE L*a*b* Color Volume page.

5. On the *Color Volume Visualizer* screen (Figure 3), under *File*, click “Open” and navigate to the .csv data file that you previously saved.
6. When you open the .csv file, the CIE L*a*b* color volume of the display that you measured will be plotted as a 3D volume. You can grab the plot and rotate it to any desired orientation.



Figure 3. Color Volume Visualizer screen.

ICtCp Color Volume

This metric is based on the ICtCp color space, included in ITU-R BT.2100. ICtCp is an absolute color space that was designed specifically for high dynamic range (10,000 nits) and wide color gamut (BT.2020) images. It describes perceptually uniform JNDs over a wide range of luminance and colors. ICtCp can be used to determine the total number of distinguishable colors that can be rendered by a display throughout its entire color volume.

Jump to [CIE L*a*b* Color Volume](#)

Hardware Connect page

Meter

1. Connect your meter to the computer, and then connect CalMAN to the meter.
2. Select the *Meter Mode* that most closely corresponds to the backlight technology for your target display type.

Source

1. Connect your HDR10-compatible test pattern source to the computer and then connect CalMAN to the source. Enable HDR10 on the *Source Settings* tab and select a 1 second source delay.
2. Select the default "Window 10%" pattern window size.

Pattern Insertion page

For measuring an LCD or OLED display, you will need to enable "Full Field Pattern Insertion" (FFPI). In the CalMAN *Settings* menu (gear wheel), under *Application Measurement Options*, configure FFPI as shown below.

LCD Window 10% pattern: FFPI Settings - Frequency: 1 , Duration: 2, Level: 0%

OLED Window 10% pattern: FFPI Settings - Frequency: 30 , Duration: 4, Level: 10%

ICtCp Color Volume page

Setup

The number of total measurement points will be indicated.

Results

The results of the ICtCp Color Volume analysis is shown in terms of the millions of distinguishable colors (MDC) able to be rendered by the display.

About Portrait Displays

Portrait Displays, Inc., since 1993, is a leading application software provider (ASP) for PC, smartphone, and tablet displays. The Portrait Displays team now includes **SpectraCal**, the world's leading provider of video display calibration software. The combined companies offer value-added, feature-rich solutions to both OEM display manufacturers and end users seeking improved accuracy and manageability of their displays.

Portrait Displays, an Intel Capital Portfolio company, is a private corporation with headquarters in Pleasanton, California, USA with representatives in Europe, Taiwan, China, Japan, and Korea.

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