Application Brief

Beyond Brightness: Why Color Gamut is Your Key to Stunning Image Quality

Oscar Loera

TI DLP® technology using RGB laser illumination delivers exceptional image quality with wider color gamut, high color accuracy and superior native contrast, setting it apart from the focus on color light output from 3LCD systems and the emphasis on low cost for 1LCD solutions.

Figure 1. Skyline With Wide Color Gamut

Wider Color Gamut

The color gamut describes a range of colors within the spectrum of colors, or a color space, that can be reproduced on a projector. Color gamut is 3-dimensional, encompassed by hue, saturation and brightness. A wider color gamut means the projector can display more colors, resulting in more vibrant, lifelike and accurate images. A color space describes a specific, measurable and fixed range of possible colors and luminance values.

The International Commission on Illumination (CIE) is the international authority on light, illumination, color and color spaces. When describing color gamut, a CIE chromaticity diagram is used, which is a two-dimensional plot representing all colors that the human eye can perceive, independent of their luminance or brightness. The three main color gamut projector standards are Rec.709, DCI-P3 and Rec. 2020.

Rec. 709 is the most common color space used in projection with a color space that is ideal for traditional high-definition content and general-purpose projectors. High dynamic range (HDR) content is most commonly mastered in DCI-P3. Rec. 709, while sufficient for standard dynamic range (SDR) content, simply does not have the color range to fully support HDR content expanded dynamic range.

Rec. 2020 provides a wider gamut, which makes colors appear more vivid and accurate, especially when displaying content like movies, games and HDR content.

Color light output (CLO) does not take color accuracy into account, and it reveals nothing about whether the projector is calibrated to retain highlight detail.

High Color Accuracy

RGB laser illumination using DLP technology eliminates the need for color filters because it directly generates light in the specific wavelengths of red, green, and blue, which are the primary colors used to create a full spectrum of visible light. This maintains consistent color reproduction across the entire image, even in dynamic scenes.

The combination of RGB lasers' ability to generate pure and highly saturated primary colors and DLP technology's precise control over individual pixels allows for projectors with superior color accuracy, a wider color gamut and vibrant, lifelike images.

Superior Contrast and Black Levels

Native contrast represents a projector’s inherent contrast ratio, determined by its ability to display deep blacks and bright whites without additional enhancements. While both DLP and 3LCD projectors utilize dynamic contrast to enhance perceived contrast, DLP projectors generally offer a higher native contrast ratio, which translates to deeper blacks and a more nuanced image, especially in darker scenes.

DLP technology uses a digital micromirror device (DMD) chip. This chip contains tiny mirrors that tilt to reflect light towards or away from the lens, creating pixels. When a mirror is tilted away, the light is directed towards a heatsink and absorbed, resulting in a true black pixel. This allows for deeper blacks and higher native contrast ratios.

Using RGB laser light sources with DLP technology provides even greater control over light output. This allows for exceptionally dark blacks, further enhancing contrast and overall image depth.

LCD panels can experience light bleed, also known as backlight bleeding. This occurs when light from the panel's backlight leaks around the edges or corners, especially noticeable on dark backgrounds. It's a common phenomenon in LCD technology and is often more visible in darker environments, which can cause black areas to appear as dark gray instead of true black.

Long-Term Performance and Durability

RGB laser illumination using DLP technology maintain color fidelity over time with minimal degradation. The solid-state laser source avoids the color decay seen in lamp-based systems. Some 3LCD systems that are reliant on lamps or LEDs experience color shift as light sources age, affecting long-term image quality. 1LCD systems, using simpler optics and lower-cost components, are prone to faster degradation, impacting both color and brightness consistency.

Color Perfection’s Cinematic Edge With Wider Color Gamut

Projector convergence, also known as panel alignment, is the process of precisely aligning the red, green and blue color components of a projector's image so they perfectly overlap. This verifies a sharp, clear and color-accurate picture, free from color fringing or blurring. Crystal panels are used in LCD projectors to concentrate colors. When there is a convergence issue, the visuals are hazy and full of inaccuracies.. An LCD panel alignment feature allows users to manually adjust the color convergence of red and blue colors in the projected image.

RGB laser illumination using DLP technology excels in delivering stunning image quality through a wider color gamut, superior color accuracy, higher native contrast and long-term consistency. These differentiators make it ideal for applications demanding cinematic visuals, such as home theater, professional displays and large venues.

DLP technology, paired with RGB laser, delivers exceptional performance by offering a wider color compared to 3LCD and 1LCD systems, ensuring vibrant, lifelike visuals for an unparalleled viewing experience.

Learn More About DLP Technology

- DLP display and projection products
- DLP optical design guidelines
- Texas Instruments: *TI DLP Products Illuminating the Way to Next-Generation 4K UHD Applications*
- The DLP® technology difference

Trademarks

DLP® is a registered trademark of Texas Instruments.
All trademarks are the property of their respective owners.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265