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Thanks to cutting-edge advancements, rainbow effect is nearly extinct. Modern 1-chip DLP® projectors boast sleek new designs, fast refresh rates and new illumination technologies like LED and RGB laser. These upgrades deliver crisp, smooth visuals with consistent colors, making rainbow artifacts a thing of the past.



Figure 1. Vibrant and Eye-Catching Image With Unparalleled Color Accuracy

What is Rainbow Effect?

The rainbow effect is a brief color flash seen in some older DLP projectors that was more common in early lamp or older laser phosphor color wheel systems. Slower refresh rates in those models cause subtle color separation for certain viewers, especially in high-contrast or fast-moving scenes. Not everyone notices the rainbow effect, as it varies by individual perception. With laser phosphor projectors featuring enhanced color wheel designs or the use of newer illumination technology such as LED or RGB lasers, projector viewers enjoy a stunning, virtually rainbow-free viewing experience.

New Sources of Illumination

Newer categories of illumination can also be used with DLP technology. These illumination types remove the use of the color wheel:

- **LED:** Solid-state illumination that is highly efficient, emitting light with much less energy consumption than traditional lamps and laser phosphor. which creates a significantly better and cost-effective image experience with excellent color saturation and color balance, high speed color switching with no moving parts, no speckle, long lifetimes and durability.
- **RGB laser:** Direct laser illumination uses three separate laser diodes, one for red, green and blue, to directly generate the primary colors. RGB pure laser projectors offer a more accurate and wider color gamut, better contrast and potentially longer lifespan compared to laser phosphor projectors.

Color overlap is supported in DLP projectors using LED or RGB laser illumination technology. Solid state LED or RGB laser illumination enables up to six times faster color switching when compared to earlier generation systems. This faster color refresh rate greatly reduces, or in our fastest color refreshing systems, can perceptually eliminate color breakup creating a DLP display viewing experience similar to what is found on TI DLP Cinema® systems. This much higher color refresh rate also enables much improved camera capture of the projected image which is an important use case.

Color Wheel Improvements

In DLP projectors using laser phosphor, the color wheel is a critical component that spins to filter light into sequential red, green, blue and sometimes additional colors, like white or yellow, to create a full-color image. Improvements in color wheel design have been instrumental in reducing or eliminating this rainbow effect artifact. Here are the key advancements:

- **Optimized segment layouts:** Modern color wheels are designed with carefully balanced color segments to ensure smoother transitions between colors. By adjusting the size, arrangement and proportion of color segments, manufacturers minimize the visibility of color separation, creating a more cohesive image.
- **Increased segment counts:** Newer color wheels often feature more segments, such as six or eight instead of the traditional three or four. This increase allows for more frequent color transition within a single rotation, reducing the time gap between colors and making it harder for the human eye to detect individual flashes by reducing the rainbow effect.
- **Faster rotation speeds:** High color wheel rotation speeds mean colors cycle more rapidly. This reduces the duration of each color's projection, making transitions nearly imperceptible to viewers and significantly lowers the likelihood of seeing rainbow artifacts.
- **Enhanced materials and coatings:** Advances in the material and optical coatings used in color wheels improve light transmission and color purity. These upgrades ensure more accurate and consistent color reproduction, reducing the intensity of any potential artifacts and enhancing overall image quality.

New DLP Display Controllers

The latest DLP display controllers provide support for more color cycle with up to 20 cycles per color in a 60 Hz system. More color cycles in a projector reduce the rainbow effect because they cycle through the primary colors (red, green, blue) more rapidly, which reduces the amount of time the eye can perceive a single color being displayed, making the separation between colors less noticeable and diminishing the perceived rainbow effect.

Shine Through With Impressive Images

Project an incredible portrayal without worrying about rainbow effect by using a DLP projector using the latest color wheel enhancement or an LED or RGB laser projector that provide color saturation and wide color gamut without using color wheels. The use of newer controllers and utilization of color overlap can also help to eliminate rainbow artifacts. Any of these solutions will deliver one of the best images in the industry.

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