

IMAGE BLACK LEVEL PERFORMANCE

By Display Solutions

Unique Solutions for Unique Problems

Black Levels and Solid-State Projectors

Solid-state projectors (LCD, DLP and their derivatives) are being used as a replacement for CRT projectors in visual display systems for simulation and training because of their brightness, fidelity and lower life cycle costs. The solid-state projector is clearly an improvement over CRT projectors in all categories except one.....black level.

What is Black Level?

The Black Level of a display device is the light output produced with no signal input. In CRT projectors, the light source (electron beam) is turned completely off. In solid-state projectors, the light source (mercury or xenon lamp) is always on.

The LCD panels in LCD projectors modulate the light using cross polarizing panels. The panels are not capable of completely extinguishing the light transmission in the off condition. At best, approximately 0.1% of the light is passed thru the panels and projected on to the screen (1000:1 contrast ratio).

DLP projectors use oscillating mirrors to control the light instead of LCD panels. It is a little known fact that the mirrors always have a partial "ON" duty cycle, even in no signal (black) scenes, resulting again in some light being transmitted to the screen.

Both technologies use beam-splitting devices in the optical block to separate and then recombine the red, green and blue components of the white light source. With thousands of lumens of light being reflected around in such a small area, there is no way to completely eliminate "stray" light from reaching the lens and on to the viewed image.

Why is Black Level Important?

Typical daytime images are composed of illuminated and non-illuminated areas represented by the palette of colors that can be provided by Computer Generated Graphics today. In these scenes, your eye will perceive the non-illumination of black objects as a function of the brightness of the illuminated or white objects. The human eyes response to this contrast ratio will "trick" the eye into perceiving the black areas as being true black. The greater the difference in illumination of an image, the higher the contrast, the blacker the dark levels appear.

In typical dusk or night scenes, the illuminated areas are dim and represent a smaller percentage of the overall image content. Under these conditions, limited Black Level performance of the display system results in a visible gray background and illuminate your training area.

Many visual display systems are comprised of multiple projectors or channels configured to produce a single, large continuous image. In these applications, the individual images from each channel have an area of overlap to insure a smooth transition of objects as they cross these boundaries. CRT projectors with their typical 400-800 lumen output used electronic edge-blending to create these overlap areas. This technique is also being used by solid-state projectors with 1500 to 5000 lumen output. However, the electronic edge-blending processors cannot compensate for the "non-black" background produced by solid-state projectors. The result is that in low light level scenes, a visible vertical band will appear in the overlapped regions of the composite image.

Are there solutions to improve Black Level on Solid State Projectors?

The response to that is unfortunately yes and no. There is no current solid state technology that meets the absolute black level that can be reproduced by a CRT projector today....nothing is better than off and solid state light valves are always on. The improved contrast ratios touted by some projector technologies is a combination of reduced "stray light" in the optical block and increased brightness in the highlight areas. The inability to completely "turn off" the light valve still inhibits reproduction of "true black". However, there are ways to approach approximately 90% of the black level capability of CRT projectors and eliminate the "banding" of the image overlap regions.

Display Solutions currently uses multiple techniques depending on the solid state projector type, the lens throw ratio and light output. These devices are a combination of optical grade neutral density filters, solid edge baffles, graduated edge baffles and bulb correction technology. These techniques, can be added to all brands of solid state projector technology and the resultant image is many steps closer to the black levels currently provided by CRT's.

Conclusion

Optimizing the "black level" performance of solid state light valve projectors in simulation theater applications requires understanding the limitations of the technologies and the capabilities of the compensation devices available and designing the visual system to match those capabilities. Display Solutions can best help you achieve the maximum performance from your theater design by working with you in the early stages of your projects. We offer services ranging from visual system design consulting to display system products including projectors, baffles and filters and electronic edge-blend processors. We can also provide complete "turn-key" visual systems including installation and alignment.



Projection Design SVGA DLP Projector with Wide Angle Lens and Edge-Blend Bat Wing Baffles (Black Level Enhancement filter not shown)

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