Interactive Projection Technologies Compared

Customers searching for an interactive projector have a growing number of models to consider. Not all accomplish interactivity the same way however. Some use infrared technology in conjunction with the projector to achieve interactivity. A group of 1-chip DLP interactive projectors embed a pattern into the projected image itself. There are distinct differences between these two technologies. For example, depending on whether the interactive functionality of the projector is turned on or off, there is as much as a 32% difference in brightness on these 1-chip systems. This paper will identify some of the relative strengths and weaknesses of each, and help customers better understand the interactivity mechanisms in both types of systems.
**Infrared**

The infrared approach to interactivity works with sensors that are external to the projection lens. In these systems, a special camera inside the projector detects the presence of infrared light, which is invisible to the naked eye. The camera works in conjunction with a special pen. Whenever the pen comes in contact with the board, infrared light is emitted at that point on the screen. This signal is picked up by the camera and the movements of the pen are tracked on the image in the same way as a wireless mouse.

To accurately track the movement of the pen, it is necessary to calibrate the camera and projection system at the time of installation. Calibration is achieved by touching the interactive pen to a series of marks on the board which are then plotted and stored in the projector. Because the camera and the projection engine operate independently, there is no impact to the image brightness when both are in use simultaneously.

**DLP**

1-chip DLP interactive projectors employ a different approach to achieving interactivity. These systems embed a special pattern into the projected image whenever interactivity is enabled. This pattern appears so quickly on the screen that it is invisible to the eye. However, the interactive pen can “see” the pattern and relays the location data back to the projector. While the interactive pattern is invisible to users, its presence in the image does result in an overall reduction in brightness.

To best understand how interactivity works in a 1-chip DLP projector, it helps to review how these projectors create an image. The DLP chip is made up of an array of tiny mirrors, one for each pixel. At any given instant, each mirror is either pointed towards or away from the screen.

Ignoring color for a moment, to create a white pixel using just the lamp and DLP chip, the mirror would be pointed to reflect the lamp light towards the screen. To create a black pixel, the mirror would be pointed away from the screen. Creating a 50% grey pixel becomes more interesting, as it requires the system to flash the mirrors on and off so quickly that they are only facing the

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1. The measurements for the Dell and BenQ models were taken by Luminit Labs, an independent third party, using the ISO 21118 standard for White Light Output and NISTIR 6657 for Color Light Output. The measurements for the Epson model are taken from a Projector Central report (May 11 2010, http://www.projectorcentral.com/Epson_BrightLink_450Wi_classroom_projector_review.htm)
2. Percent change calculated as percent increase in brightness when interactivity is disabled
3. The BenQ MP780st does not allow the use of interactivity in its brightest mode. The 1977 lm measurement was obtained in Dynamic mode. When interactivity is activated the projector goes back to Presentation mode where the measurement of 1486 lm was obtained. In presentation mode with interactivity disabled a measurement of 1682 lm was seen, for a 12% change in brightness.
screen approximately half of the time. At any given instant, the pixel on the screen would be either all white or all black...but your brain averages these bursts into 50% grey.

To create colors, these 1-chip systems use a color wheel. Lamp light filters through the color wheel where the light is broken into short bursts of different colors; red, green, blue, yellow, cyan, magenta, and white (depending on the color wheel). Although the DLP system is only creating one color at a time, our visual system works too slowly to see each burst of color. Rather, our brain averages these short bursts of color and white light over a period so that we perceive the various colors on the screen.

Combining the short multiple flashes of color is referred to as time sequential color projection.

To understand how interactivity works within a DLP projector, it is critical to start with an understanding of time sequential color projection. Why? Because, the pattern that is required for interactivity is embedded in this sequence, and becomes part of the overall image on the screen. In other words, while all of the short bursts of color and white are hitting the screen forming the image we see, another special interactive signal is also being added to the image.

This interactive signal is made up of a special pattern of scrolling bars. The bars are flashed on the screen so quickly that we can’t see them. Although too quick for our eyes, the interactive pen can see them. Working together, the pen and projector communicate to identify where the pen is pointing based on the hidden pattern on the screen.

Since the special pattern is embedded in the image on the screen, DLP interactivity does not require calibration and the user can use the pen either at the screen or away from the screen. These are relative advantages of DLP interactivity versus other technologies.

The major drawback to interactivity on a DLP is that while the interactive pattern may be hidden from our eyes, it does lower the overall brightness of the image. The actual change in brightness may be anywhere from 15% to 32% depending on the model and mode. Also, since the pen must be able to continuously read the pattern, any shadowing that appears on the image area can disrupt and temporarily disable the interactive function.
To picture the drop in brightness, consider the images to the right. These were taken at an independent laboratory of the Dell S300Wi interactive projector at a speed of 1/8000th of a second. The top image says Interactive Off. The image on the screen is actually an all-white background with a black font. The camera is so fast that it can see the blue, white, cyan and green segments of the color wheel at one time.

The next two images say Interactive On...also with a white background and black font. Again, we see the different segments of the color wheel as it is spinning...but we also see distinct black bars. These are the bars the interactive pen is watching for and are required for interactivity to work. Because the bars are themselves dark in color, they unavoidably reduce the brightness of the projector. Again, we cannot see the separate colors or black bars in our normal viewing. But, what we can see is a drop in brightness.

How much brightness do these 1-chip DLP interactive projectors lose? The table on page two summarizes the measured lumens with and without interactivity. The measurements show a change in brightness as high as 32%.

Brightness has always been a cornerstone of projector image quality. A bright projector can produce crisp, bold images even when lights are on. A substantial reduction of brightness will impact overall image quality, particularly in well-lit environments such as classrooms and conference rooms with windows and overhead lighting.

Projector buyers are increasingly asking for interactivity. When shopping for an interactive projector keep in mind the different technologies and look for a solution that does not sacrifice brightness or image quality.