Understanding the Difference Between

ANSI Lumens and LED Lumens

ViewSonic follows industry standard ANSI methods to establish our projector brightness specifications, but ANSI brightness alone can't always provide enough information to fully characterize the brightness performance of the latest generation of high-color gamut projectors with LED light sources. This is mainly due to something called the HK (Helmholtz-Kohlrausch) effect, which causes observers to perceive images with higher color saturation to be brighter than the less saturated ones.

Now imagine two projectors with the same measured ANSI lumen brightness that appear to be at different brightness levels. To understand how this is possible, we must also understand that the human eye is more sensitive to certain wavelengths of light (Fig 1), and any projector with a light source that more closely matches the light response of the human eye will naturally have a higher perceived brightness.

Figure 1 below helps to further illustrate the Helmholtz-Kohlrausch effect. Most observers would assume that the colored patches on the left are brighter than the gray scale patches in the center; in actuality, they have the same measured ANSI lumen brightness. In addition, while the colored patches on the right may appear to have the same brightness as the center gray scale patches; however, the ANSI lumen brightness of the colored patches on the right is much lower than the center gray patches.

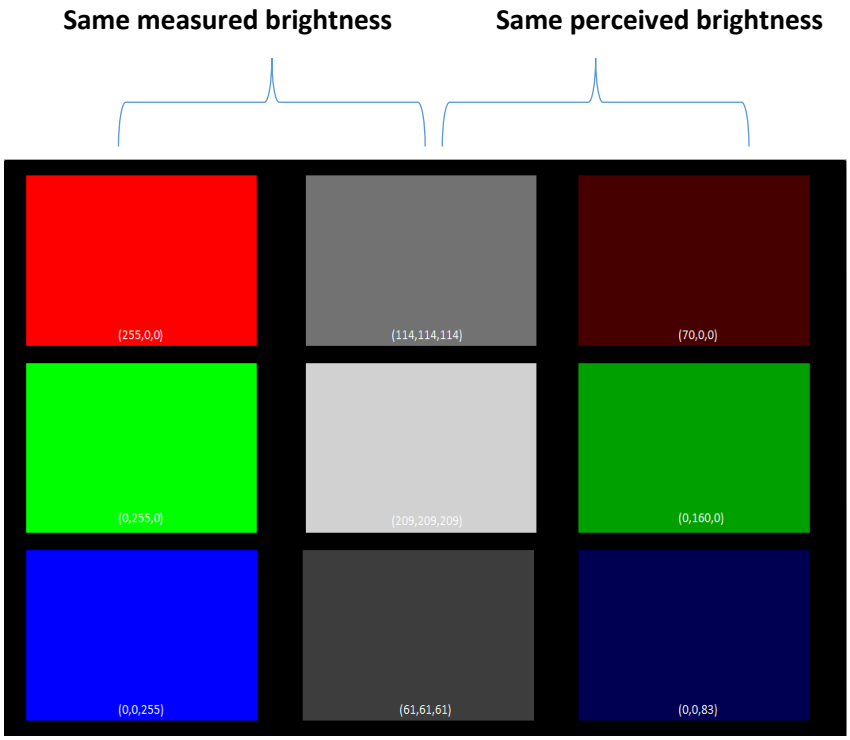

Figure 1. Measured vs. Perceived Brightness

(Simulated image to illustrate the HK effect)

Figure 2. attempts to illustrate how the perceived brightness level varies color by color. The x-axis of this chart shows each individual RGB color compositing the light source on the LED projector. The y-axis shows the brightness comparison between the colors on the left and right column on Figure 1. The perceived brightness ratio is the difference between the perceived brightness with the measured brightness, while the average perceived brightness ratio is the difference with all of the colors combined. Both ratios can be calculated by using the formulas below.

*the 2.4x average perceived brightness ratio is determined by Viewsonic LED projectors, other LED projectors may have a different result

$$**Perceived\ \ Brightness\ \ Ratio\ = \frac{(Red\ 100\%\ or\ Green\ 100\%\ or\ \ Blue\ 100\%\ )lumens}{(\ Red\ visual\ \ or\ Green\ visual\ or\ \ Blue\ visual)\ \ lumens}$$

$$***Average\ Perceived\ Brightness\ Ratio = \frac{(Red\ 100\%+Green\ 100\%+\ Blue\ 100\%\ \ )\ lumens}{(\ Red\ visual\ +Green\ visual\ +\ Blue\ visual)\ lumens}$$

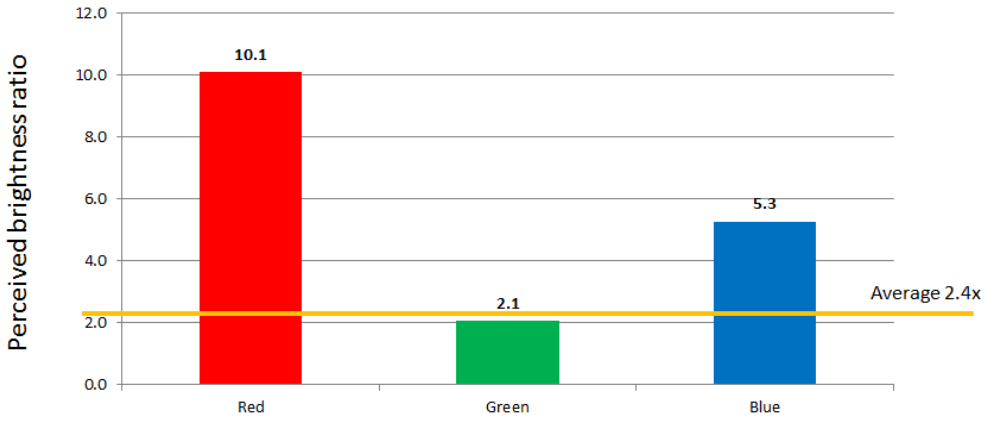

Figure 2. Magnitude of the HK effect with Red, Green, and Blue monochromatic lights

By observation, we know that many projectors with LED-based light sources have higher perceptible brightness than many lamp-based projectors, even though they may have the same measured ANSI lumen rating. To understand why, simply refer back to Figure 1 and understand that the colored patches on the left only appear to be brighter because the human eye is more receptive to highly saturated colored light, so an LED projector with colors that are more concentrated in wavelengths will be perceived as being brighter. This is why ViewSonic has committed to provide both ANSI and LED lumen ratings for our latest LED projectors.

Determining the typical LED lumen specification for a given LED projector first requires the selection of a lamp-based reference projector with an RGBRGB color wheel. The individual R, G, B currents of the LED projector are then adjusted until the perceived brightness most closely matches that of the reference lamp-based projector. Another ANSI lumen measurement of the adjusted LED projector is then taken, and the ratio of these two measurements is multiplied with the ANSI lumen measurement of the reference lamp-based projector to determine the equivalent “LED lumen” rating.

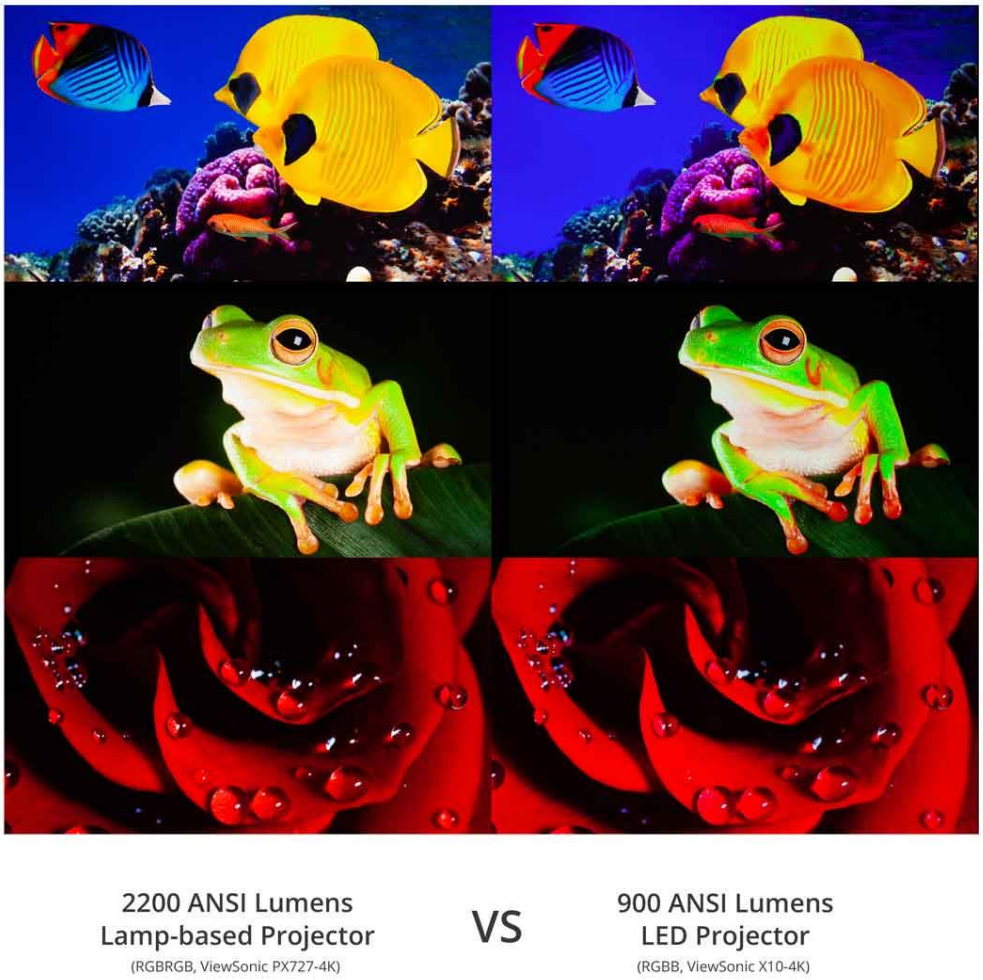

Figure 3. Sample image of a 2200 ANSI Lumen lamp-based projector (RGBRGB, ViewSonic PX727-4K) vs. a 900 ANSI Lumen LED projector (RGBB, ViewSonic X10-4K)

*The 900 ANSI Lumen LED projector was reduced from 1000 ANSI to 900 ANSI to match the approximate brightness of the 2200 ANSI Lumen lamp-based projector while maintaining the same 2.4x average perceived brightness ratio

In addition to a higher perceived brightness, projectors with LED light sources also tend to have a higher luminous efficiency, meaning less wasted energy, more energy efficient, higher perceived light output, wider color gamut, and stunning image quality all help to make the latest ViewSonic LED projectors a very compelling solution.

References

1) E. Fred Schubert Light Emitting Diodes 3rd Edition (E. Fred Schubert, New York, 2018)

2) Wyszecki G. and Stiles W. S. Color Science – Concepts and Methods, Quantitative Data and Formulae 3rd edition (John Wiley and Sons, New York, 2000)

3) Mike Wood – Lightness- The Helmholtz-Kohlrausch effect (Out of Wood, Summer 2012)

Disclaimer

This white paper is intended for discussion and information purposes only. The information and specifications contained herein are subject to change without notice.