What's Your (White) Point?

By: Brad Schiller

Additive LED fixtures have come a long way in a relatively short amount of time. I remember the first RGB (red, green, blue) fixtures claimed to make white by combining all three emitters at full, but really, it was a lame lavender color. You then had to fiddle with the values to try to find something that looked more like white. Your final selection still was not great and often lacked intensity. Luckily, as the technology has improved, we have been presented with several options to improve the quality of white light from additive color mixing fixtures.

Just add white

The next evolution towards quality white light was for manufacturers to add a white LED to the standard red, green, and blue LEDs. Now we had RGBW fixtures and a way to either simply turn on white or add white to the RGB mixes. Initially, this seemed like a great idea, and it was certainly better than just RGB. We could achieve a really nice-looking white and still have lots of output, too. Unfortunately, the color rendering from this mix was not ideal because the white LEDs were still missing important wavelengths. However, thousands of RGBW fixtures still grace our stages today and provide decent enough white light for many applications.

Throw more colors at it

A few manufacturers saw the need for a better quality white and improved color mixing ranges, so they added even more LED emitters. Deep red, indigo, light blue, amber, and other colors have been combined with RGB to create a great range of mixing options. By combining some or all of these options, the white output has a greater variation of wavelengths and massively improved color rendering abilities. However, this comes at an increased cost and is also much more difficult to work with when you have five or more colors to combine.

Around this time, consoles still limited their color pickers and engines to work only with RGB, thus making use of these added emitters labor-intensive. You had to manually manipulate any colors beyond RGB to create ideal white output.

Along came lime

The engineering geniuses who create the actual LED chips also saw the need for high-quality white output and designed a lime LED that wonderfully fills in the wavelength holes when using RGB. Combining RGB with lime gave us tremendously high color rendering abilities and added visible output increases as well. Now, nearly every major manufacturer is using lime in their additive fixtures, giving us RGBL systems. Some are even including additional emitters for a greater color range.

Keep it simple

With all these options and various colors, it can be daunting for a programmer to create the perfect combination of values that equals the best output of white. For instance, how do you create 3,250K white from an RGBL or RGBALI system? Ideally, you want to create a "perfect" mix of wavelengths to equal a standard that represents the color of white at a specific color temperature. The most common metric is to refer to the black body curve and see how close your white mix equals the expected color spectrum of the defined color temperature. This is commonly accomplished with a light meter that measures the Duv (delta UV) of the white at a specific color temperature.

Wait! I just said I would keep it simple, and now this section has become very complicated. And therein lies the problem of picking your white point. While you might make a mix that you think looks like 3,200 Kelvin, it could be very far off the black body curve, thus making things look poor onstage or on camera. One solution is to use a light meter when creating your mix. Another newer tool is to use GDTF files with sophisticated lighting console algorithms that utilize the wavelength information in the GDTF file to provide proper settings of desired color temperatures.

Pick your white point

There is an even better method that you might find built right into your lighting fixtures. Many fixtures provide various modes related to working with color. One of my favorites utilizes algorithms to simplify your white point selection. They allow you to only work with RGB parameters directly, while the algorithm handles the other emitters to ensure the best total output at all times.

With these systems, you will have a CTC (correlated color temperature) channel where you choose your desired white point from a range of color temperatures. For instance, when you set this channel to 4,500K, the algorithm will use all the emitters to output a perfect 4,500K with the right wavelengths that closely match the black body curve. Usually, these settings are calibrated per fixture at the factory, so they are as exact as possible.

Once you have set a CTC value, anytime you bring red, green, and blue to full, the output will be at your desired white point setting. Plus, you can often further modify this with a tint channel to adjust the magenta or green within the white output to match your other stage lights or camera settings. Just like the CTC setting, the tint values are independent and will restore anytime the RGB channels are at full.

Many programmers think that these systems are limiting, due to the lack of access to emitters other than RGB. However, because the fixture's algorithm is always working, you are always getting the best color and output from the unit. For example, when you mix a pastel amber using only RGB, it might add in some lime or white as determined within the fixture's color space. This is extremely useful as the algorithm typically calculates a better mix than most programmers.

Going direct

Of course, there are times when you want full control of the LEDs and not let the fixture decide how to mix. This is why fixtures have various color modes after all! Usually called direct or raw mode, this gives you independent control of each of the fixture's emitters. However, you usually then lose the CTC and tint channels. This means that if you want a perfect 4,500K white output, you will have to work with RGB, lime, white, and any other LEDs to create the correct wavelengths of output.

Some consoles have wonderful systems for working with color and use their own algorithms to provide console-based CTC and tint functions when using direct modes. In addition, their advanced color systems often rely on GDTF data to fully integrate the actual wavelengths of the individual LEDs into their calculations, thus creating beautiful output possibilities.

Choose wisely

When white light is used for illumination, there are many things to consider with LED fixtures. Before you begin programming, you need to decide what mode to assign to the colors in your fixtures. Then ensure you understand the tools that the fixture and consoles provide for achieving the best white point possible. There are many different "versions" of white, and you need to be able to easily select the best one for your show. Happy picking!