

Color Tuning Definition and Benefits

Product: Leviton LED Controls

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Summary:

This document will define the concept of color tuning and explore its benefits to room occupants, employees and business owners. We will also determine the best Leviton product solutions to accomplish color tuning objectives.

What is Color Tuning?

Color tuning refers to the control of colors emitted by a room's lighting in order to produce a predetermined color. Intentional lighting color design can lead to a host of benefits, including:

- Improved employee productivity and morale
- Superior ambiance and increased guest satisfaction in hospitality and restaurant applications
- Optimal display of products in retail settings, leading to increased sales
- Better learning environments and attendance in education applications

Although artificial white lighting is described as “white,” there is a wide spectrum of white shades varying in intensity and what colors they evoke the human eye to interpret from the space and objects they illuminate. This variation is known as “color temperature,” a value measured in Kelvin (K).

On the visible color spectrum, all colors visible by the human eye including the primary colors (red, green and blue) and all hues made by mixing them combine to create what we see as White. White can be specifically crafted, however, by mixing select colors together to achieve a specific color temperature.

White light with strong overtones of red and orange is normally described as being “warm” and has a lower temperature of 2200K.

White light with strong overtones of blue is described as being “cool” and has a higher color temperature of 5000K.

In order to accomplish this specific lighting design goal, technologies fall into three different categories:

Dim to warm refers to adding red or amber lights to an LED fixture, with a second driver that exclusively controls these warm lights. When the fixture dims to a low K level, the red lighting is raised to create a warmer, more even and more pleasant dimmed lighting effect. This is also sometimes referred to the “sunrise effect,” as it mimics the warm and pleasant natural lighting of a sunrise- or sunset-illuminated space.

Tunable white lighting contains two sets of controllable LEDs, one warm and one cool. The two lighting sets can be raised and lowered in an endless amount of combinations to produce dimmed or full-ON lighting that conforms to the user's desired color temperature. These lighting combinations can be preset with control systems as scenes, providing different lighting temperatures for a variety of scenarios, times of day, etc.

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Full color tuning fixtures have three or more LED primary colors that can be individually controlled and varied to create desired hues, whether they be pure white, white tinted/dimmed, or a saturation of any other color. This method provides the greatest level of flexibility and customization, allowing users to set the room to any hue along the visible spectrum. They are also the most difficult and complicated to use and control.

End-User Benefits of Color Tuning

Advanced LED fixtures that utilize color tuning technologies open up a host of new possibilities and benefits for building occupants and owners.

- Match natural daylight cycles indoors to keep occupants in tune to the rhythm of sunlight throughout the day, providing visual cues about the time of day and retaining a sense of connection with the outdoors for increased satisfaction and productivity
- Enhance spaces utilizing daylight harvesting by more accurately matching the hue of natural light
- Individual customization of private offices, guest rooms, conference rooms and other smaller spaces
- Scene capabilities to vary the light level and hue based on what the space is currently being utilized for, such as presentations, work/task hours and special events
- Retail customization to reflect the current product lines, seasons, merchandising scheme, and more
- Set restaurant dining areas to cool during lunch hours and warm during happy hour and dinner
- Ensure constant, smooth color output from LED lighting throughout dimming and lamp life

Retail applications rely on high color quality to make products like clothing and accessories appear more vibrant, truer and ultimately more appealing.

Office applications can be improved with specific color schemes that facilitate social interaction with naturally-rendered skin tones and faces, creating a more appealing and productive work environment.

Healthcare applications benefit from creating a welcoming, home-like atmosphere and rendering skin tones more accurately to help detect illnesses such as jaundice, rashes, infections, fevers, and other conditions with visual cues.

Hospitality applications depend on spaces being inviting and appealing as a critical component of business; color tuning allows the space to be precisely designed to match furnishing colors and materials and adjusted later for furniture changes and building updates.

Education applications have been the subject of studies, such as one recently conducted by the Transfer Center for Neuroscience and Learning that showed students in classrooms with color tuning lighting produce higher standardized test scores (Source: *The Right Color: Color Tuning*, <http://www.ecmag.com/section/lighting/right-light-color-tuning>).

Color Tuning Technology

There are many ways color tuning technology is being implemented with more options continually rolling out. Sometimes the technology resides in the controller, while other times it resides at the load (for example inside the ballast, driver, or dimmer). Understanding the components of your system and how they implement color tuning technology will help you design the appropriate solution for your application.

Color tuning profiles built into the load controls: Some drivers support color tuning technology at the driver. Configuration is either fixed and set by the factory or field configurable with a programming tool, jumper settings, or other method. This is seen mostly in application like “warm dim” where the color temperature shifts to lower color temperatures as the output level decreases. In this case, the control signals are provided as normal and the load control does all the work.

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Color tuning profiles driven by the controller: In this application, color tuning is driven by the controller with information communicated through control signals to the load controller. In these cases, either multi-channel drivers or multiple independent drivers are used to control each of the controllers producible by the fixture. The control signals, which move between the controller and the fixture, are the same style of control signals commonly used in other fixtures, with many choices available to suit a variety of control applications. Common control signals include 0-10V and DMX.

Although each technology has specific strengths and applications, one of the most important considerations to make is to ensure your controller technology matches your fixture technology, or that a gateway is included in the control system to convert between the controlling and fixture control signals.

Leviton Premier Color Tuning Solution: Sapphire Room Controller

Leviton offers a comprehensive color tuning solution in the form of the Sapphire Room Controller.

- Allows for color tuning pre-programmed settings along with scene control, scheduling and AV controls
- Harnesses the capabilities of LED lighting fixtures to adjust the overhead lighting tones to different levels along the warm/cool color temperature spectrum
- 0-10V and DMX capabilities
- More information available at Leviton.com/sapphire