COLOR**KINETICS**

Chromasync

Optimize output and color consistency

Technical Overview

Chromasync

Chromasync brings new consistency to dynamic color luminaires

Color consistency refers to the average amount of variation in chromaticity among light sources.[1] On a more human level, it refers to the amount of perceived variation in color in lighting of any variety. Color consistency is an important criteria for judging the quality of LED lighting – of both white-light and dynamic color luminaires.

In the context of dynamic color luminaires, achieving color consistency is even more important – particularly in large-scale implementations using multiple luminaires. Ensuring color consistency via traditional methods is time-consuming and challenging, requiring specialized expertise and programming. Binning[2] technologies – such as Optibin™ – help minimize variations by evaluating LEDs and grouping those with similar characteristics. But that's not enough for demanding full-color applications. Breakthrough Color Kinetics Chromasync technology takes consistency even further, ensuring that variations in color will not be visible to the human eye, and greatly simplifying the process of achieving color consistency.

1   Lighting Research Center at Rensselaer Polytechnic Institute

2   Binning is a post-manufacturing process that groups LEDs that fit within a specified standard

Why Color Consistency Matters

Digital disruption is followed by an inevitable move toward standardization and consistency – as shown in technologies as varied as digital printing, photography, and music.

Why? Because consumers demand consistency. We want music and photos in consistent formats that achieve predictable levels of quality. We also want lighting environments that are consistent, whether they're created with white-light or dynamic color LED luminaires.

Upon introduction to the marketplace, white-light LEDs exhibited noticeable levels of variation across and within product lines. Now, thanks to a concerted effort by manufacturers – including Color Kinetics – to improve consistency, there is a high level of consistency in white-light LED luminaires. These luminaires achieved consistency first as they are much more widely used than dynamic color luminaires. So consumers generally experience consistent white light in the home, office, and elsewhere.
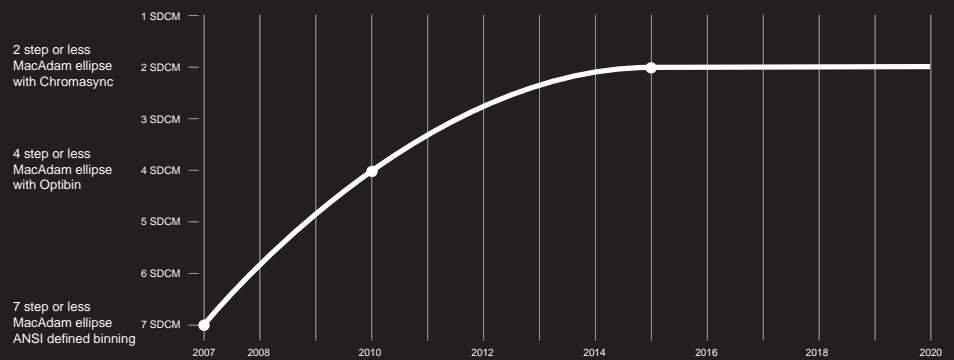
The evolution of consistency in white-light LED luminaires

But what about the color consistency of color-changing LED luminaires? As iconic buildings, public spaces, galleries, retail stores, and other locations use dynamic color lighting for impact, ambiance, and excitement, the need for consistency is becoming more critical. After all, high-end lighting applications and environments cannot tolerate noticeable variations in white light or colors, upon installation or over time. Color consistency is vital to achieving an artistic vision, reinforcing a brand, and making the right impression. The larger and more complex the installation, the more critical color consistency becomes.

Color Kinetics and color consistency

Today's lighting applications demand consistency of color and output, posing a challenge that must be addressed by dynamic color luminaires. As the pioneer in LED lighting solutions, Color Kinetics recognized this challenge and developed Optibin technology to ensure consistency by drawing upon performance information of the LEDs used during manufacturing. Binning is a post-manufacturing testing and sorting process that makes it possible for manufacturers to select LEDs (or more accurately, groups or bins of LEDs) that conform to stated specifications – minimizing variation at the LED level. The result? Higher consistency.

However, when two or more channels are mixed together – or when multiple channels are used to create white light (e.g., RGB, RGBW, RGBA) the consistency of the luminaire output can still vary as much as 10 – 15 MacAdam ellipses, resulting in noticeable color shifts. This variation points to the need for a new, even more stringent approach to consistency – one designed to meet the needs of increasingly sophisticated dynamic color lighting applications.

Achieving consistency today

Traditionally, these variations are resolved via time-consuming programming and specialized expertise. While binning technologies such as Optibin are a solid first step toward improving luminaire-to-luminaire color consistency, lighting professionals still find themselves committing considerable time during commissioning to achieving the highest levels of consistent color. This time-consuming, labor-intensive process is complicated, often involves "guess and check" adjustments, and is frequently left off the work plan – making achieving color consistency via traditional methods a potentially costly effort.

It's clear that the lighting professionals who are responsible for achieving color consistency are looking for a simpler, faster, and better way to deliver color consistency, **especially** in applications using challenging mixed colors. For flexibility, this solution must allow specifiers to use any third-party 3-channel controller, without requiring a specialized controller for implementations that use luminaires with four or five channels.

Lighting specifiers need to ensure that all luminaires output the same color – that's the definition of color consistency in the real world.

How Color Variance Is Perceived and Measured

In a traditional RGB context (the CIE XYZ color space), the varying amounts of red, green, and blue can specify a particular color point accurately. But the way differences in color are perceived by the human eye is much more complicated.

During experiments by scientist David MacAdam in the 1940s, observers viewed two colors at the same luminance – one was a fixed "test" color, while the observer could adjust the other. The colors that different observers perceived to be matches with the test colors varied, thanks to the inherent sensitivities of the human eye and the subjectivity of observation. But the research found that the matches fell into an ellipse on the CIE 1931 chromacity diagram.

MacAdam's results confirmed earlier suspicions that color difference could be measured. Today, the lighting industry bases measurements of color consistency based on MacAdam ellipses (also referred to as Standard Deviation of Color Matching or SDCM), as well as other standards. Today Δ^E 2000 is the quantitative measurement used to indicate the just-noticeable difference between two colors.
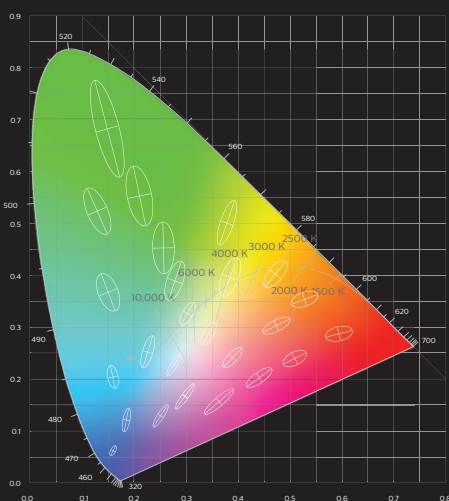
MacAdam elipses enlarged to show detail.

Understanding Chromasync Technology

Color Kinetics developed Chromasync technology to meet the growing need for color consistency in dynamic color LED luminaires, particularly when used in multi-luminaire applications.

Photography: Darius Kuzmickas

This proprietary technology is the result of broad and deep lighting expertise and years of research. Integrated into Color Kinetics luminaires and software, Chromasync enables lighting professionals to achieve a high level of color consistency without the complex adjustments and expertise required in the past. And users can achieve this level of color consistency with controllers from Color Kinetics and third-party DMX controllers. In short, Chromasync automates the process of achieving color consistency.

Chromasync is a complete, proven system that maintains color consistency and intensity. At its core is a proprietary algorithm that automatically adjust the luminaire to a common gamut. It integrates with Color Kinetics software to recognize specific luminaire types and families.

During commissioning, the installer simply activates Chromasync to start achieving advanced color consistency. Most Color Kinetics RGB, RGBA, RGBW, and IntelliHue luminaires are Chromasync capable.

How Chromasync works

The goal of Chromasync is to provide consistent light performance across multiple luminaires. It enables luminaires that have different color signatures (or gamuts) – due to manufacturing variances or multiple LED sources – to match a specified color point, creating color consistency.

Chromasync accomplishes this goal in phases. First, it applies the Optibin binning optimization process. Besides assuring the general uniformity and consistency of the LEDs used in a luminaire, Optibin data is also used to define the common gamut that can be achieved by the luminaire. In short, it defines a baseline gamut. Then after assembly, we measure the intensity and color space position of the individual channels from each luminaire. These measurements define the luminaire gamut.

Once Chromasync is enabled, the Chromasync algorithm adjusts the gamut of the luminaire automatically to ensure that all luminaires achieve the same consistent gamut. The result? A significant leap forward in color consistency, one that eliminates the need to adjust the color of individual luminaires during commissioning to account for differences in output.

Precision vs. Accuracy

Chromasync brings the color points of luminaires closer together, but it also shifts the set of color points slightly in relation to the black-body curve. Another way to put this is that Chromasync enhances color precision, while leaving color accuracy unchanged.
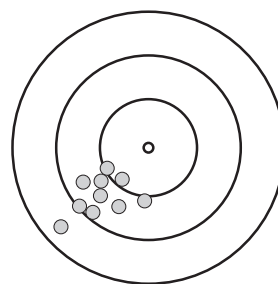
Chromasync OFF
(standard precision)
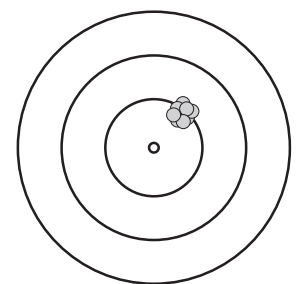
Chromasync ON
(enhanced precision)

Unprecedented color consistency with Chromasync

Our Chromasync technology delivers improved color consistency from luminaire to luminaire by precisely adjusting the color point.

Consistency
Chromasync allows the IntelliHue family of luminaires to achieve high color precision with a color variation of less than two MacAdam ellipses across multiple luminaires.

Color Accuracy
Chromasync enables lighting designers to pick a specific Correlated Color Temperature (CCT) via the Color Kinetics software and ensure accuracy – achieving their vision, protecting brand consistency, and much more.

Maximum Output
Chromasync ensures consistency, but also optimizes the luminaire for maximum output for the chosen color point, as well ensuring consistently high output for specified colors.

Speed
Chromasync simplifies and speeds commissioning by replacing time-consuming adjustments with an automated process integrated into the lighting solution and controller.

Flexibility
Chromasync is controller-agnostic and works with 3-, 4-, and 5-channel controllers, including those from Color Kinetics as well as third-party controllers. It only requires a 3-channel controller to operate 3-, 4-, and 5-channel luminaires when Chromasync is enabled in 3-channel mode.

Photography: © Darius Kuzmickas

Color Kinetics technology portfolio

We continually explore your challenges, invest in research and development, and make the significant commitment required to develop and perfect breakthrough technologies. The result of decades of work, our unequaled portfolio of proprietary, quality-enhancing technologies helps you achieve the best possible results. These technologies increase quality by ensuring sustainability, consistency, raising uniformity, providing precision control, and more.

Optibin

Where consistency begins.

Our LED optimization technology begins the color consistency process by grouping (or binning) LEDs by flux as well as center wavelength. This proprietary binning optimization process uses an advanced bin selection formula that exceeds industry standards for chromaticity. The result? Higher uniformity and consistency of hue and color temperature for all our luminaires.

Chromasync

Optimize output & color consistency.

Our advanced output optimization technology controls and boosts output while ensuring color consistency. When enabled, Chromasync ensures excellent color consistency between luminaires, without manually adjusting color points on each luminaire.

IntelliHue

The smart way to deliver white & color light.

Our advanced approach to color mixing produces high-quality white light, subtle pastels, and fully saturated colors in the same precisely controllable luminaire. All with unrivaled color accuracy across the entire range of color temperatures.

OptiField

Uniformity never looked this good.

OptiField's freeform optic creates a breakthrough rectangular beam that covers large surfaces with full, bright, even light. And OptiField can cover more surface area with fewer luminaires — simplifying installation while lowering energy use.

Powercore

Power made simple.

Our patented approach to power output proves that simple is better. As well as faster, more efficient, and accurate. Powercore® controls power output to luminaires directly from line voltage. It merges line voltage with control data and delivers both over a single standard cable—dramatically simplifying installation and lowering total system cost.

IntelliPower

Retrofit made easier.

IntelliPower is a groundbreaking implementation of proven power line carrier technology (PLC), a system for carrying data on the same conductors used for transmitting electrical power. By applying the principles of PLC, IntelliPower lets you install and digitally control intelligent Powercore luminaires using existing electrical branches, 2 + ground wiring, and luminaire mounting points.

What matters in professional lighting?

Our series of guides explores key topics in professional lighting—Color Science, Light Matters, Quality Matters, Optics Matter, and more. It's part of our commitment to passing on our deep technical knowledge and decades of expertise to help you achieve your vision.

Color Science

Color science serves as an underlying technical foundation for the entire lighting industry. It establishes a consistent way of thinking about light—how it is created, controlled, and delivered in real-world implementations. A core understanding of the science of color is critical to lighting professionals, who must be able to specify the right light—color, technology, luminaire, and more—clearly and accurately.

Light Matters

Traditional methods of evaluating light focused on lumen output, which was defined by the output capabilities of a light source, such as an incandescent lamp. The advent of LED lighting changed all that, since lumens were no longer the best measurement of a luminaire's capabilities. We explore some of the new ways lighting can be evaluated in the age of LED.

Quality Matters

What does quality mean to you?

The answer depends on what you do within the lighting industry. Quality has different meanings for building and site owners/managers, lighting designers, and installers.

We delve into the needs of each of these groups as we take a holistic approach to quality, one that begins and ends with the customer.
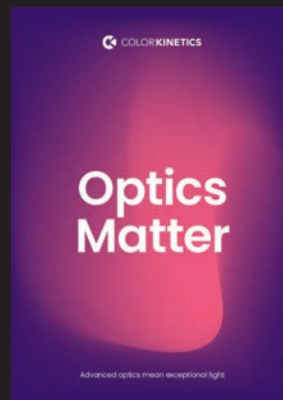
Optics Matter

It's safe to say that few lighting designers, building owners/managers, or other lighting professionals have ever seen the optical system housed inside an LED luminaire. But the optical system, or optics, play a vital, but often hidden role in performance, efficiency, and more. The right optics within a luminaire make a big difference in the final results—for both interior and exterior applications.

Choose the luminaire that meets your needs

Chromasync is just part of the ongoing effort by Color Kinetics to set new standards for consistency. These technologies work together to deliver the accuracy required by innovative and ambitious dynamic color applications.

To find out more about how to make Color Kinetics luminaires part of your next lighting design, visit www.colorkinetics.com

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