COLOR KINETICS

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 it'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

Chromasync CK Technology

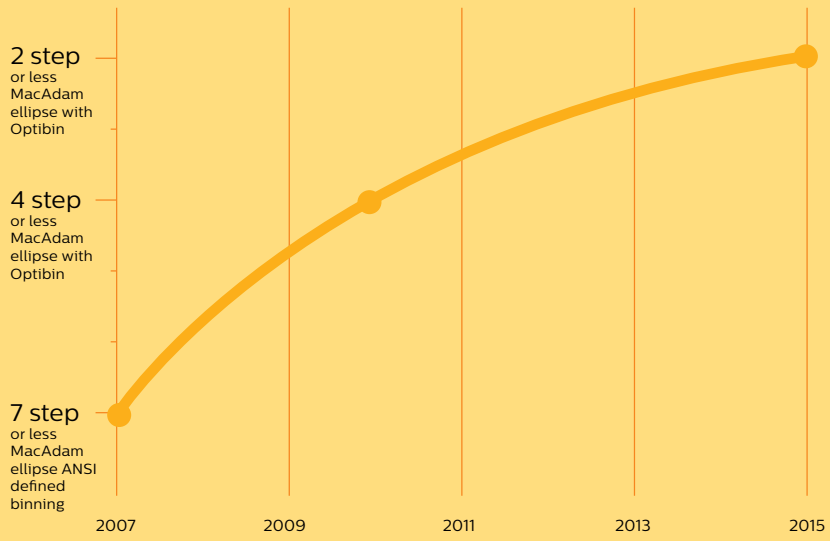
Chromasync is an advanced algorithm that delivers improved color consistency from luminaire to luminaire, by adjusting the node's color point. With Chromasync enabled, colors are more consistent, regardless of the specific LEDs used, date of manufacture, and other manufacturing variables. Chromasync allows Color Kinetics luminaires to achieve high color precision. Luminaires within the IntelliHue family achieve color variation of less than 2 MacAdam ellipses (2 SDCM) across multiple luminaires. Chromasync brings new consistency to RGB, RGBW, RGBA, and IntelliHue luminaires. And Chromasync allows for high system flexibility, enabling use of a 3-channel controller – no matter how many different colors are required.

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 Signify – 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

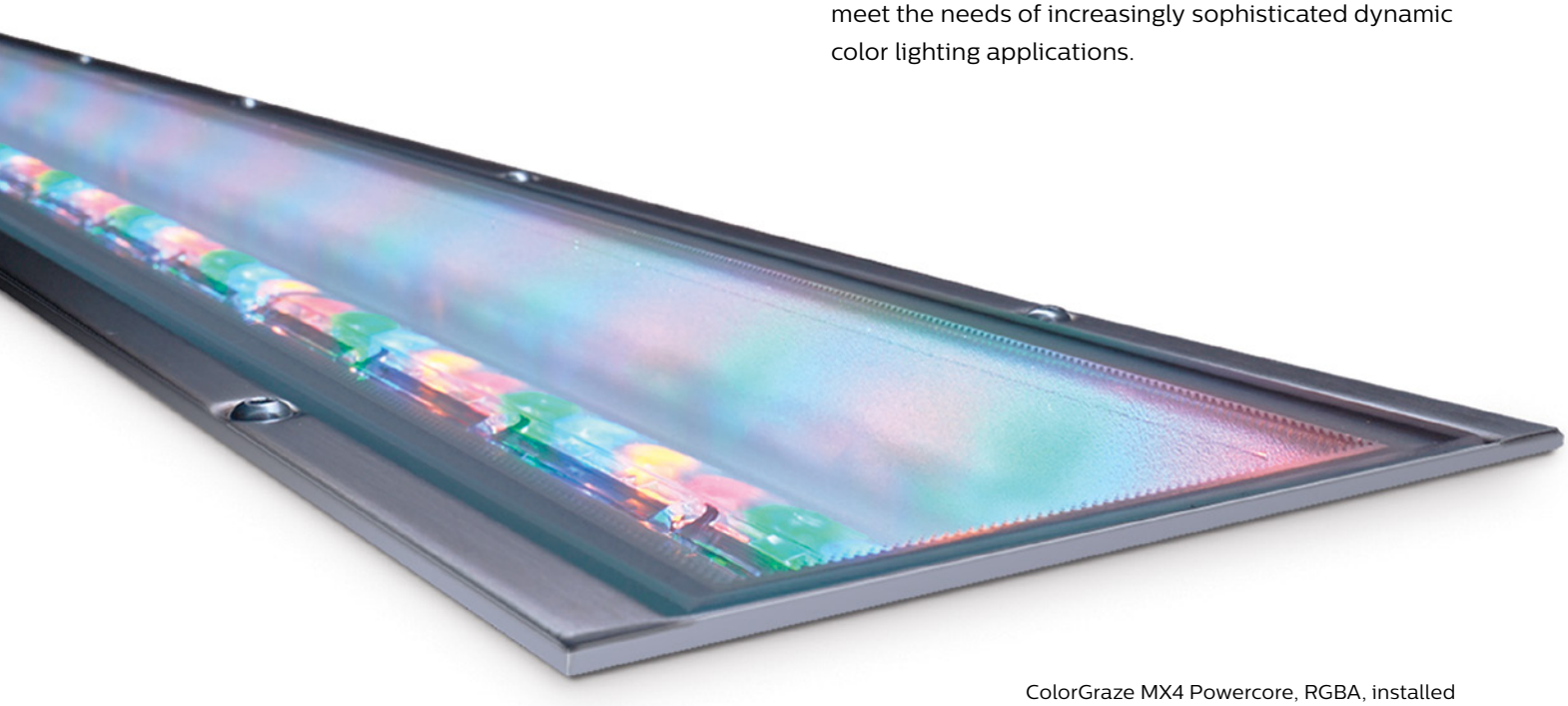
Big Four Bridge, Louisville, Kentucky, USA

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. Thanks to the high level of consistency achieved by white-light LED luminaires, there are higher expectations for consistency in color-changing LED luminaires as well.

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.



ColorGraze MX4 Powercore, RGBA, installed in an Inground Enclosure offers an expanded palette of intensely saturated full-color light in a variety of beam angles.

How is consistency achieved today?

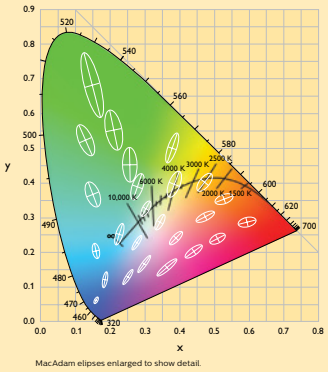
Traditionally, these variations are resolved via time-consuming programming and specialized expertise. While binning technologies such as Optibin are a solid first step toward improving luminaire-to-luminaire color consistency, lighting professionals still find themselves committing considerable time 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 even in applications using challenging mixed colors. What's needed? An easier, more reliable way to ensure color consistency without requiring high-level expertise or time-consuming work during commissioning, all while optimizing output. 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.

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

A Closer Look at 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 that color accurately. But the way differences in color are perceived by the human eye is much more complicated.



MacAdam elipses enlarged to show detail.

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.

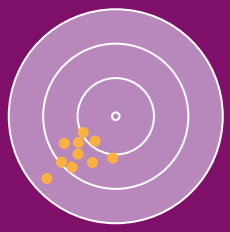
Understanding **Chromasync** Technology

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.

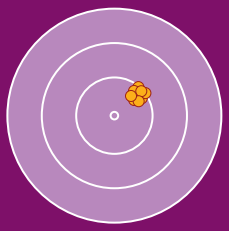
This proprietary technology is the result of broad and deep lighting expertise and years of research. Integrated into Color Kinetics luminaires and software, Chromasync enables lighting professionals to achieve a high level of color consistency without the complex adjustments and expertise required in 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 fixtures are Chromasynce capable.



Chromasync OFF
(standard precision)



Chromasync ON
(enhanced precision)

Precision vs. Accuracy

Chromasync brings the color points of fixtures 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.

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.

Thunder Valley Casino Resort, Lincoln, California, USA

The Benefits of Chromasync

The beneficiaries of Chromasync are the lighting designers, building owners, artists, dealers, and others who use color LED light as part of their work – plus the public, which sees only seamless, uninterrupted color light.

Here are the main benefits that Chromasync delivers:

Consistency
Chromasync allows the Color Kinetics 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.

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.

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.

Chromasync and Color Kinetics

Lighting Technologies

and Solutions

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

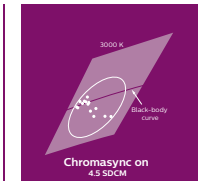
Optibin

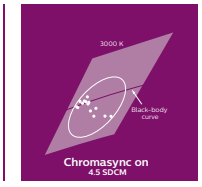
As highlighted earlier, Optibin® begins the color consistency process by grouping (or binning) LEDs by flux as well as center wavelength. This proprietary binning optimization process uses an advanced bin selection formula that exceeds industry standards for chromaticity to guarantee uniformity and consistency of hue and color temperature for Signify lighting products.

For more information on the Optibin proprietary binning optimization process, refer to the Optibin Technology Overview, which you can download from the LED Education section of www.colorkinetics.com/ls/guides-brochures/

Chromasync

Chromasync capability is available on many Color Kinetics IntelliHue LED Lighting Systems, initially including Blaze TRX, Blast TRX, Color Graze EC, QLX, MX, MX4, SkyRibbon IntelliHue, PureStyle, iColor MR G3, Blast G4, Burst G2. As additional luminaires integrate Chromasync technology, they will be able to achieve advanced color consistency. Chromasync is an evolving technology and its integration into Color Kinetics advanced LED lighting systems is ongoing. Please check with your Color Kinetics representative to determine the current availability of Chromasync within Color Kinetics luminaires.





ColorGraze MX Powercore RGB fixtures with Chromasync off and on

IntelliHue

IntelliHue is an advanced approach to color control and mixing that produces an enhanced spectrum of precisely controllable light, including millions of saturated colors, pastels, and precisely controllable, high-quality white and tinted white light. By combining carefully selected channels of LED light sources, IntelliHue enables high-quality dynamic color and white light from the same luminaire. Chromasync enables Color Kinetics IntelliHue luminaires to achieve an extremely high level of color consistency (<2 SDCM), rendering color variations virtually imperceptible.

For more information on IntelliHue advanced color control and mixing, refer to the IntelliHue Technology Overview, which you can download from the LED Education section of www.colorkinetics.com/ls/guides-brochures/

Allianz Arena, Munich, Bavaria, Germany

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