IntelliHue

Precisely Controllable
Full Color and High-Quality White LED Light

Technology Overview
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Groundbreaking IntelliHue color-control technology offers unprecedented color performance, precision, and range for both colored and white LED light. IntelliHue technology delivers enhanced spectral content for precise control of color, color temperature, and tint. With IntelliHue, you can easily target and precisely adjust millions of colors and shades white light around the black-body curve.

For white light, IntelliHue’s enhanced spectrum allows for:

- Precise color tuning in an expansive range extending from 2000 K (firelight) to 10000 K (blue sky) along the black-body curve
- Precise tinting and shading of white light points in a generous region extending above and below the black-body curve (+/- 0.06 Duv)
- An extremely high level of color consistency (<2 SDCM) in tandem with Chromasync, rendering color variations virtually imperceptible

IntelliHue combines all the benefits of IntelliColor, IntelliWhite, and Essential White technologies and makes them available in a single fixture, while adding an unprecedented ability to target and tint white-light color points.

IntelliHue, an advanced approach to color control and mixing, 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 intelligent color and white light from the same fixture.

**IntelliHue**

- 80+ CRI across 2700 K – 4000 K range
- <2 SDCM color variation with Chromasync
- Rapidly target white points and precisely adjust CCT and tint
- High-quality tunable white light and color-changing effects from the same fixture

**IntelliWhite**
Intelligent control of a range of color temperatures

**IntelliColor**
Intelligent control of millions of saturated colors

**Essential White**
High-quality, highly uniform white light
Spectrally Enhanced LED Light

LED light sources for IntelliHue fixtures are carefully selected to enhance spectral content, resulting in superior color rendering (CRI) in the white range and fine control of color, color temperature, and tint.

Enhanced Spectrum for Superior Quality of Light

CRI measures the ability of a light source to reproduce the colors of various objects faithfully in reference to an ideal light source. The index rates the quality of a light source on a scale up to 100. By definition, the ideal reference source — the sun, for example — has a CRI of 100. A light sources that renders colors in exactly the same manner as the ideal reference source would also have a CRI of 100. In practice, the color rendering abilities of all light sources differ from the ideal reference source to a greater or lesser degree. The more their color rendering differs, the lower their CRI score.

In applications requiring demonstrable light quality — for example, in general illumination applications in art galleries, restaurants, high-end retail spaces, and other interior spaces — a CRI of 80 or higher is an important benchmark. While it is widely understood that CRI has some limitations in its application to LED light sources, good CRI is still a meaningful factor in evaluating LED lighting solutions for white-light applications.

Incandescent light sources can achieve nearly perfect CRI by producing a continuous spectrum across all of the visible wavelengths (colors of light). In contrast, the spectral profiles produced by standard RGB LED fixtures are characteristically “spiky,” with intense light output in relatively narrow bands of the visible spectrum. This uneven spectral distribution accounts in large part for the low CRI scores of white light produced with RGB LED sources.

Incandescent lamp spectrum

Standard RGB LED fixture spectrum, all channels full on
LED lighting fixtures employing a single channel of white-light LED sources at a specific color temperature, such as the Essential White line of fixtures from Philips Color Kinetics, produce a profile with more content across the visible spectrum, routinely achieving CRI scores of 80 and above.

![Graph of 3000 K LED fixture spectrum](image1.png)

Single-channel LED lighting fixtures can produce white light of comparable quality to the best incandescent and fluorescent sources, but they can’t be intelligently controlled — they can be switched and dimmed only. IntelliHue fixtures, in contrast, combine enhanced spectral content and high CRI with precise, intelligent control of saturated color, color temperature, and tint of white light.

![Graph of SkyRibbon IntelliHue Wall Washing Powercore, all channels full on](image2.png)

The combination of color and white-light LED sources in IntelliHue fixtures can deliver tunable white light with high CRI across a range of color temperatures. For example, SkyRibbon IntelliHue Wall Washing Powercore outputs highly uniform white light with a CRI of 85 or greater across the 2700 K – 4000 K range.
Enhanced Spectrum for Precise Control of Color, Color Temperature, and Tint

IntelliHue fixtures afford a high level of control in selecting and adjusting color points, especially shades of white light.

Shades of white light lie along and around the black-body curve, which describes an arc within the CIE 1931 color space. In 2008, the American National Standards Institute (ANSI) published ANSI C78.377-2008, “Specifications for the Chromaticity of Solid-State Lighting Products.” ANSI C78.377-2008 defines 8 nominal color temperatures (CCTs) for LED light sources, ranging from 2700 K (warm) to 6500 K (daylight). These CCTs are used by the LED lighting industry to enforce a baseline of consistency in the definition and appearance of LED white light.

Each nominal CCT has an allowable range of variation (tolerance) both along the black-body curve and perpendicular to it. Variations that lie along the black-body curve, measured in degrees K, make a light source appear more reddish or bluish. Variations above and below the black-body curve, notated in Duv, make a light source appear more greenish or pinkish.

Specified variations in CCT and Duv define a quadrangle within the color space for each color temperature. The quadrangle for nominal CCT 3000 K, for example, is centered on 3045 K, and extends 175 K left and right along the black-body curve and 0.006 Duv above and below the curve.

IntelliHue fixtures can produce a range of color temperatures and tints of white that far exceed the boundaries of the ANSI white range. IntelliHue, therefore, defines a white range that is much more expansive than the ANSI range. For SkyRibbon IntelliHue Powercore fixtures, for example, “white” ranges from 2,000 K to 10,000 K along the black-body curve, and 0.025 Duv above and below it.

In practice, this means that you can control IntelliHue fixtures to target and precisely adjust white points across and beyond the entire ANSI white range. At one end of the black-body curve, you can select super-warm candle flame and reddish firelight shades in the 2000 K – 2500 K range. At the other end of the black-body curve, you can select super-cool daylight and blue zenith sky shades in the 7000 K – 10000 K range.

In addition, you can liberally and precisely tint white points pink or green by moving them above and below the black-body curve.

This unparalleled freedom in producing white light allows you to match the hues of other lighting technologies, create pastels, and produce the exact custom shade of white you desire.
Enhanced Definition of Colors and Shades of White

IntelliHue-aware color definition interfaces, such as those available in the iColor Keypad Effect Manager and ColorPlay 3 light show authoring and configuration software, give you a fine level of control over targeting and adjusting shades of white.

For shades of white, the interface presents the IntelliHue white range as an area around the black-body curve on the CIE 1931 color space. To define a starting point, you simply click on the white range, or select from a set of popular pre-defined whites. The software automatically calculates the individual channel values, allowing you to pick shades of white in a natural way. You can then use the CCT, tint, and individual LED channel sliders to precisely adjust the color temperature and hue of the selected white point as desired.

If you’re connected to a lighting network, Live Play functionality lets you instantly see the changes you make on installed fixtures for rapid configuration and color definition.

**How IntelliHue Fixtures Produce White Light**

IntelliWhite and Essential White fixtures from Philips Color Kinetics produce white light using only channels of white-light LED sources at one or more color temperatures. IntelliHue fixtures, on the other hand, produce high-quality white points by combining output from channels of white-light and colored LED sources. As a result, non-white-light channels may be on slightly to achieve a specific CCT.

In most cases, point sources are not visible in an installation. To ensure a seamless viewing experience, you can use accessories — such as louvers for SkyRibbon IntelliHue Wall Washing Powercore and SkyRibbon IntelliHue Wall Grazing Powercore — to shade and conceal a fixture’s LED light sources.
If you want to define a color outside of the IntelliHue white range, you can switch to the RGB Range to select a color from a set of color spectrum, color detail, and color field controls. Five-channel IntelliHue fixtures afford five degrees of freedom for defining color points and white points, allowing for significantly finer adjustments than are possible with three-channel IntelliColor or IntelliWhite fixtures.

Keep in mind that while IntelliHue technology affords fine control over adjustments of CCT, tint, and hue, IntelliHue fixtures are not calibrated with x,y coordinates or other color reference points. Often, viewer preference is the deciding factor in selecting white and color points in lighting applications. However, you must use a light meter or other light measuring device if achieving a specific, demonstrable color temperature or x,y point is critical to the success and acceptance of your application.

Unprecedented Color Precision

IntelliHue works with our patented Chromasync technology to achieve unprecedented color consistency and uniformity across fixtures in an installation.

Chromasync

With Chromasync, the unique gamut (color range) of LED lighting fixtures in a family is defined using a calibrated light measurement device during manufacturing. Calibration information is stored on each fixture, along with Chromasync color consistency algorithms. When Chromasync is turned on, each fixture's on-board logic automatically adjusts all fixtures in an installation to a common gamut. With all fixtures using the same gamut, color consistency is greatly improved, eliminating the need to manually adjust the color points of each fixture using controller or configuration software.
The color points of fixtures displaying the same output values in an installation can be visualized as a set of points scattered over an area of the CIE 1931 color space. For standard RGB fixtures displaying white light (all channels full on), color points are typically spread over an area of roughly 10 MacAdam ellipses (10 SDCM) — larger than the ANSI CCT definitions, which allow for variation of around 7 MacAdam ellipses (7 SDCM). Enabling Chromasync brings the color points of RGB fixtures closer together — to around 4 MacAdam ellipses (4 SDCM), or much better than called for in the ANSI chromaticity standard.

This improvement in color consistency is significant, and often good enough for applications where highly uniform white light is not required.

<table>
<thead>
<tr>
<th>Precision vs. Accuracy</th>
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<td>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.</td>
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### Philips Color Kinetics fixtures employ Optibin, a proprietary binning optimization process, to guarantee uniformity and consistency of hue and color temperature for Philips lighting products. For more information, refer to the Optibin Technology Overview, which you can download from the LED Education section of www.philipscolorkinetics.com/ls/guides-brochures/

### For more information on Chromasync, refer to the Chromasync Technology Overview, which you can download from the LED Education section of www.philipscolorkinetics.com/ls/guides-brochures/
IntelliHue + Chromasync

When combined with Chromasync, IntelliHue fixtures can produce consistent, uniform white light that meets or exceeds the most stringent requirements for high-quality white light applications.

With Chromasync enabled, for example, SkyRibbon IntelliHue Wall Washing Powercore achieves color variation of less than 2 MacAdam ellipses (2 SDCM) across multiple fixtures in white light applications — differences that are virtually imperceptible to the human eye.

SkyRibbon IntelliHue Wall Washing Powercore fixtures with Chromasync off and on

![Graphs showing color variation](image-url)
Color-Changing Effects and High-Quality White Light from the Same Fixture

IntelliHue surpasses the limitations on the range of colors that standard LED lighting fixtures can produce. With IntelliHue, a single LED lighting fixture can deliver millions of saturated colors, pastels, and high-quality, tunable white light.

IntelliHue-enabled LED lighting fixtures from Philips Color Kinetics offer unparalleled design flexibility and control over the lighting environment. In addition to producing dynamic, saturated, full-color effects, Fixtures such as SkyRibbon IntelliHue Powercore can both illuminate spaces with highly uniform, high-quality digitally adjustable white light to support a range of business, retail, hospitality, and other activities, and transform spaces with intensely saturated, dynamic accent and effect lighting for dramatic presentations, theatrical atmospheres, and special occasions and events.

SkyRibbon IntelliHue Powercore
These recessed linear LED wall washing, wall grazing, and linear direct fixtures feature IntelliHue technology to deliver digitally controllable color-changing and high-quality intelligent white light to interior spaces.

Above left, SkyRibbon IntelliHue Wall Washing Powercore brilliantly illuminates an interior space with highly uniform white light. Above right, digitally controllable fixtures deliver intensely saturated color-changing light to dramatically transform the space.

At right, SkyRibbon IntelliHue Linear Direct Powercore fixtures provide both professional general illumination and stunning, full-color effects to interior spaces.
You can fine-tune the white-light output of IntelliHue fixtures for an array of effects and applications, including:

- Matching the hues of fluorescent and incandescent lighting sources in an installation
- Blending lighting with daylight, or following the daylight cycle from cooler color temperatures in the morning to warmer color temperatures in the evening
- Allowing occupants of a space to adjust the color temperature, tint, and intensity of lighting to increase comfort and productivity
- Adjusting the color appearance of light for changing retail displays, or to encourage desired occupancy behavior in indoor spaces