



# DOE SSL R&D Directions Color-Tunable Lighting


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# Color-Tunable Lighting - Looking Back


2017 DOE SSL R&D Workshop

LED Track 1: LUMINAIRE INTEGRATION, DRIVERS, AND CONTROLS – Opportunities and challenges for developing luminaires that demonstrate value beyond traditional lighting expectations

2017 DOE SSL R&D Workshop – Long Beach, CA

## Dynamic lighting solutions

- Common approach to Tunable White
  - LED luminaire is designed as a 2-ch/2-CCT system
  - Control & “Color Science” is in a separate controller
  - Full system in installed/commissioned at the site
- OEM approach
  - LED luminaire is designed as Tunable White system
    - Digital driver supports the “Color Science” on-board
  - System is installed at the site w/ standard controls (0-10, DALI)



**LightShape**

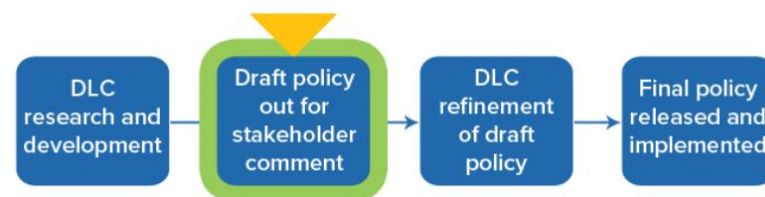
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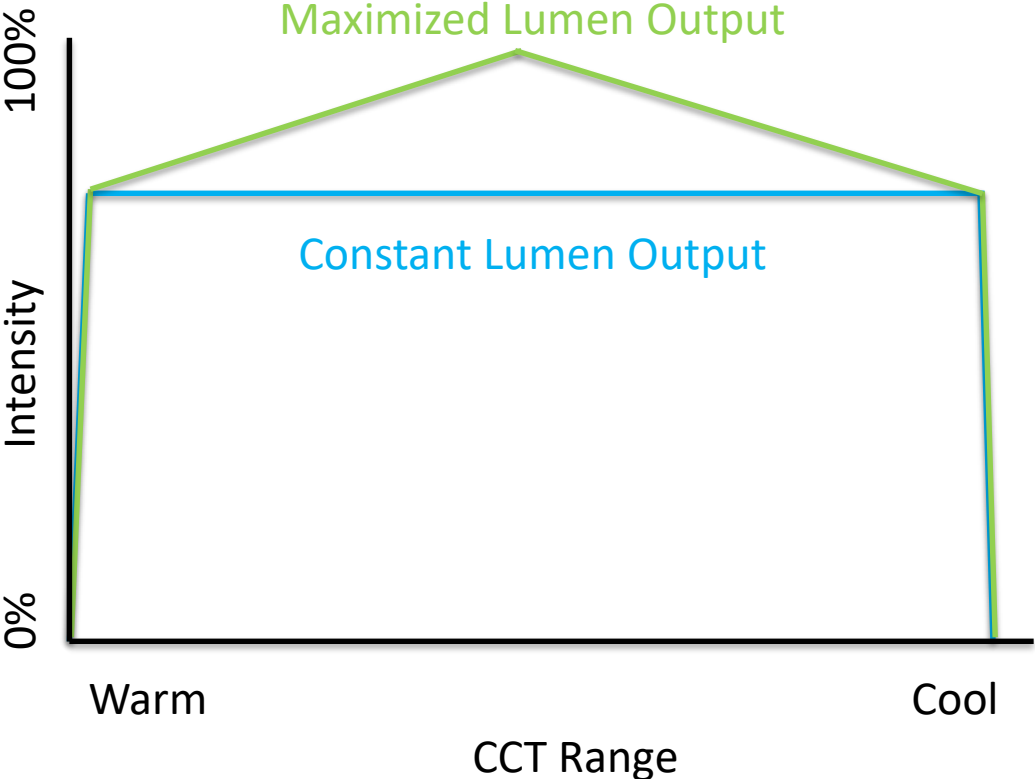
# Color-Tunable Lighting – Energy Efficiency Requirements

## Design Light Consortium: Testing and Reporting Requirements for Color-Tunable Products

- For systems designed to provide “white light”
  - Tunable white & Warm dim
  - 2 drive output (white) & 3+ drive output (RGB+)
- Specifically notes “ $D_{uv}$  below the ANSI basic quadrangles”
- Must meet DLC Technical Requirements for defined General Application
  - Field adjustable output requires additional testing
- Worst case family testing
  - Min/Max/Middle CCT range
  - Highest Power/Lowest Efficacy @ max output
- Control Interface
  - Methodology, Standards & Protocols



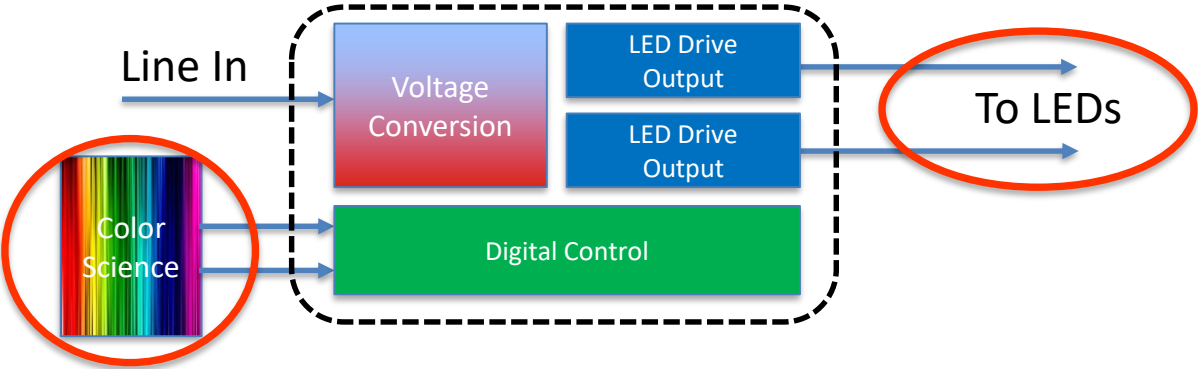
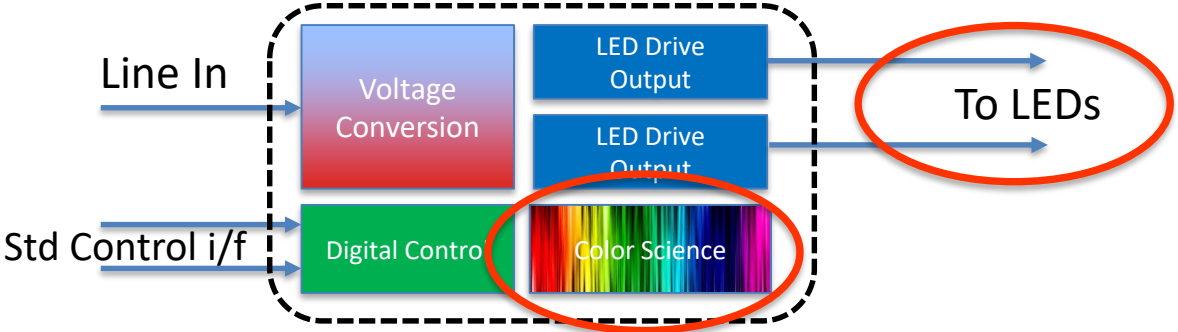
# Color-Tunable Lighting – Energy Efficiency Requirements vs. Market Requirements



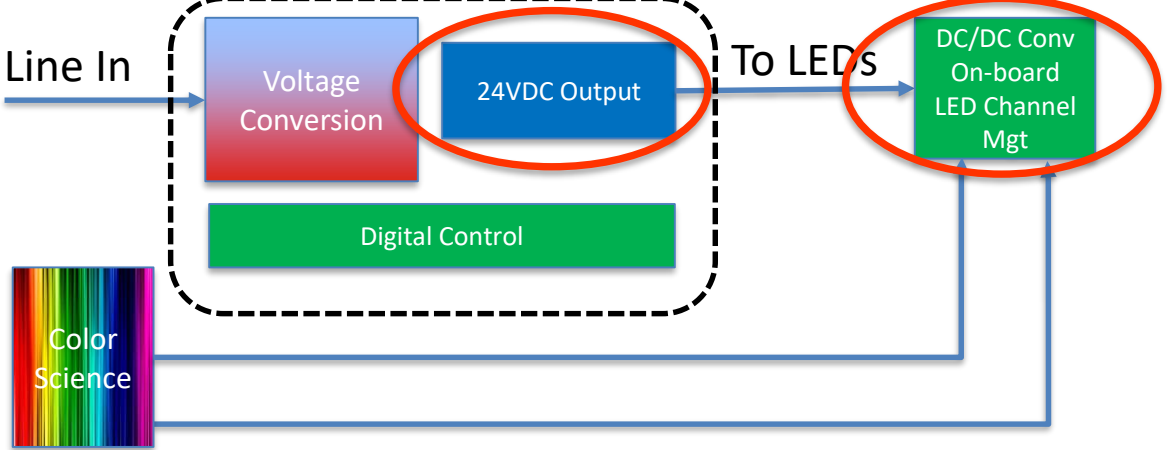
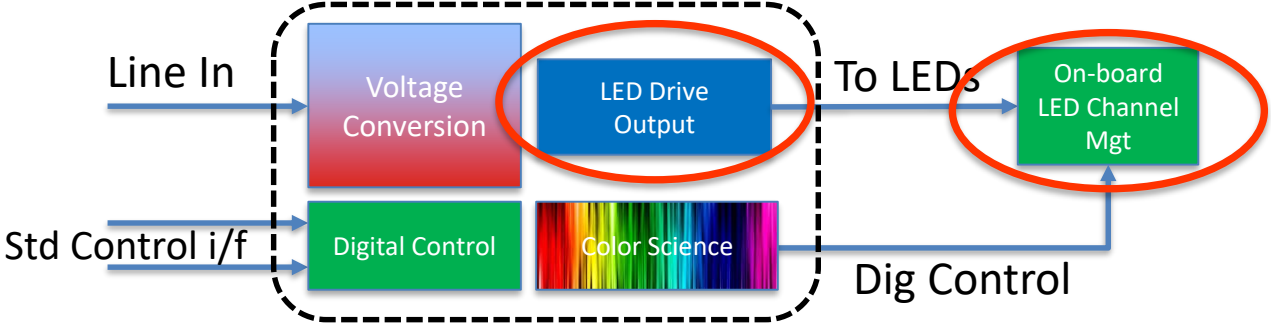
Constant Lumen Output	Maximized Lumen Output
Light levels stay the same	Get the most out of LEDs
Lighting designer like this	Overlighting? Changing the Space?
“Limiting” the system efficiency	Driving the system to its “Fullest”

# Color-Tunable Lighting – LED Driver Architecture Options

## Present



## Future



# Color-Tunable Lighting – Lessons Learned...The Hard Way

## Arup Boston's New Office: A Lighting Laboratory

Despite the obstacle of heavily tinted windows, Arup's new Boston office achieved WELL certification due in part to its lighting design.

By Timothy A. Schuler



Darrin Hunter, courtesy Dyer Brown



Darrin Hunter, courtesy Dyer Brown

- Specification
  - CCT range
  - Intensity curve
  - Constant vs. Maximum Lumen Output
- Installation
  - Proper control network sizing
  - Commissioning – Intensity/CCT channels
  - Not all problems are due to the driver
    - Driver configuration in production
    - Fixture internal wiring


# Wrap-up

- Solutions for TW continue to evolve from both a LED source/drive and control perspective
- Standard are keeping pace
- Because of the flexibility of a dominantly digital system design, the application options are broad and at times, outpacing the standards
- The market is adopting dynamic lighting solutions w/ each installation being a learning experience.

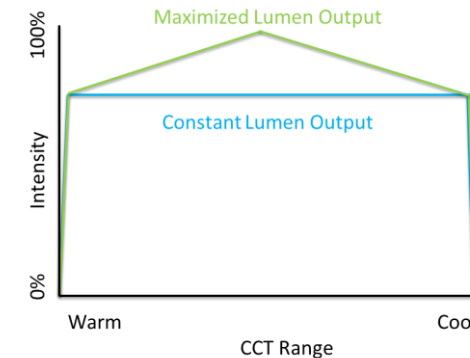
20170605 08:02 Workshop - Long Beach, CA

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LightShape AcuityBrands



Draft policy for stakeholder comment



### SECOND DRAFT Testing and Reporting Requirements for Color-Tunable Products

Color-Tunable products must comply with the provisions of this document to be eligible for listing on the DLC Solid-State Lighting Qualified Products List (SSL QPL). Color-Tunable products are defined as products whose Correlated Color Temperature (CCT) can be adjusted via an input control of any type and whose chromaticity approximately follows the blackbody locus, providing white light at all input configurations. For this purpose, white light is defined as points within set D<sub>u</sub> limitations in accordance with ANSI C78.377-2017 Extended Specification, which allows D<sub>u</sub> below the ANSI basic specification, but not above. Products supplying colored light (i.e., those capable of illuminating color points with D<sub>uv</sub> magnitudes outside of the limits of the ANSI extended specification—also known as Full Color-Tunable—are outside the scope of these proposed requirements and ineligible for listing at this time. Color-Tunable products must utilize a control interface or multiple interface options clearly described in the product literature that allow for at least two CCT settings. These may be continuously-variable inputs such as a 0-10V DC signal, an established protocol such as DALI or DMX, a proprietary control signal, settings options described in terms of CCT such as 3000K or 5000K, or simple descriptive terms such as 'Night' or 'Day'.

#### Type Definitions of Color-Tunable Products

Two types of Products are eligible for listing as Color-Tunable:

1. **White-Tunable products**, have a control signal specifically for adjusting CCT while maintaining essentially constant lumen output. These products may include a second, independent dimming control. White-Tunable products include both "white-white" products that combine the output of 2 LED primaries, and products with 3 or more white and/or RGB LED primaries, so long as they only produce white light as characterized above in response to their control signal.

DLC SECOND DRAFT Testing and Reporting Requirements for Color-Tunable Products Page 1 of 7  
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Darin Huester, courtesy Dyer Brown



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