FUNDAMENTALS OF LED LIGHTING

What are the benefits,
What are the limitations

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WHAT ARE THE BENEFITS?
LONG LIFE

Between 25,000-100,000 hours +
LUMENS PER WATT

More light for less energy
QUALITY OF LIGHT
LESS HEAT

Less energy directly affects how much heat is produced
How Do LEDs Work?
LETS LOOK AT THE COMPONENTS
THE SCIENCE
A CLOSER LOOK

This simplified illustration of an LED demonstrates how photons are released when electrons cross the p-n junction to fill holes in the p-type layer. The plastic shell covering the LED directs the photons outward.
WHAT'S INSIDE?
EVERY 12 TO 13 DAYS A NEW LED PRODUCT IS INTRODUCED TO THE US MARKET...
WHAT CAN GO WRONG
NOT ALL DIMMERS WORK THE WAY YOU EXPECT....
ALWAYS REVIEW THE DIMMER COMPATIBILITY CHART
# Titanium Series 4.0 BR30 8W 8BR30G4DIM

## Dimmer Switch Compatibility

<table>
<thead>
<tr>
<th>Brand</th>
<th>Series</th>
<th>Model</th>
<th>Load</th>
<th>Dimmability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lutron</td>
<td>Eco-dim</td>
<td>D-600PG</td>
<td>600W</td>
<td>OK</td>
</tr>
<tr>
<td></td>
<td>Maestro</td>
<td>MA-600</td>
<td>600W</td>
<td>OK*</td>
</tr>
<tr>
<td></td>
<td>Diva</td>
<td>DV-600PR</td>
<td>600W</td>
<td>OK</td>
</tr>
<tr>
<td></td>
<td>Skylark Contour</td>
<td>CTCL-153PDIH</td>
<td>600W</td>
<td>OK**</td>
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<tr>
<td></td>
<td>Skylark</td>
<td>S-600</td>
<td>600W</td>
<td>OK</td>
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<td></td>
<td>Toggler</td>
<td>TG-600PR</td>
<td>600W</td>
<td>OK</td>
</tr>
<tr>
<td>Leviton</td>
<td>Vizia *</td>
<td>VF106</td>
<td>600W</td>
<td>OK</td>
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<tr>
<td></td>
<td>Sure Slide</td>
<td>6603</td>
<td>600W</td>
<td>OK</td>
</tr>
<tr>
<td>Cooper</td>
<td>Aspire</td>
<td>9540</td>
<td>1000W</td>
<td>OK</td>
</tr>
</tbody>
</table>

*Minimum 3 lamps

**Minimum 2 lamps

### Table Key

OK= Fully compatible  
- _= % = Compatible within this range, flicker outside the range  
X= Incompatible

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*GREEN CREATIVE has provided this dimmer switch compatibility chart for guidance when selecting a dimmer and lamp combination. Our lamps were tested for compatibility with the above listed dimmers. Dimmers that do not appear on the chart might still be compatible but have not been tested. All testing has been performed with a stable main supply. The quality of the local main, existing installation and wiring, as well as different manufacturer versions of the above dimmers may affect dimming performance. Since no assurance can be provided regarding these factors, it is a general recommendation to perform a test on-site prior to installing the LED lamps.
PHASE CUT DIMMING
Typical products that use Phase Cut Dimming
TRAILING EDGE VS. LEADING EDGE
LEADING EDGE (TRIAC)

- Incandescent or magnetic low voltage (resistive load)
- Current is turned off at the front of the wave form.
- Inrush of voltage every half cycle, produces high inrush current applied to LED components causing buzzing and flickering.
- Less dimming range 35%-100%
- Most common type of dimmer currently in use.
TRAILING EDGE
(ELECTRONIC LOW VOLTAGE)

- Electronic Low Voltage (capacitive loads)
- Current is turned off at the back of the waveform,
- No inrush of voltage, or buzzing, less chance for flickering.
- Better dimming range typical 15%-100%
MINIMUM LOAD

- Phase Cut Dimmers as well as Electronic Low Voltage Transformers often have minimum loads.

- Minimum load issues can arise during dimming operation.
0-10V DIMMING
Typical products that use 0-10v Dimming
- Smooth dimming
- No Flicker
- Designed to work with LED
- Widest Dimming Range 1%-100%
HEAT CAN BE A REAL PROBLEM
PROPER THERMAL MANAGEMENT IS A MUST
MAKE SURE THE PRODUCTS ARE RATED FOR THE APPLICATION THEY ARE INTENDED FOR.
JUST BECAUSE IT’S “LED” DOESN’T MEAN IT’S A GREAT PRODUCT....
- LED product should be “passively cooled”
- Heat should be more prevalent at the heat sink NOT the diode
- Warranty should be at least 3 year
- Is there optical control?
- Is it listed?
IT'S VERY EASY TO OVER LIGHT....
LIGHT IS DELIVERED DIFFERENTLY WITH LED
- Divide the total mean lumens of the “to be replaced source” by 3
- Take 1/3 that value
- Multiply by the S/P ratio if CCT or Kelvin Temperature is changing.
HPS 400

$45,000 \div 3 = 15,000$
Find the closest light source you intend to replace, and find the closest light source or color temp to your intended replacement.
EXAMPLE
If our total value is 15,000 mean lumens and we apply our SP multiplier
15,000 x .62 = 9,300
15,000 x 1.49 = 22,300

HPS @ 2000K (S/P Ratio .62)  LED @4000K (S/P Ratio 1.49)
WHAT IS BUG RATING AND WHY IS IMPORTANT

-“Forward Light”
-Backward Light
-Uplight
-Glare

“the amount of light emitted from a luminaire in unwanted directions”
UNWANTED LIGHT

Is no fun….
OUR NEIGHBORS DON'T LIKE IT
OUR NIGHT SKY IS IMPORTANT
ESPECIALLY IF IT DOES THIS....