

# PhlatLight® White LED Illumination Products

## CSM-360 Series

### Features

- Extremely high optical output: Over 6,000 lumens from a single package (White)
- Extremely high efficiency: Over 100 lumens per watt 3.15A
- High thermal conductivity package - junction to heat sink thermal resistance of only 0.90 °C/W
- Four large, monolithic chips with uniform emitting area of 36 mm<sup>2</sup>
- Lumen maintenance of greater than 70% after 60,000 hours
- Environmentally friendly: RoHS compliant
- Variable drive currents: less than 1 A through 6.3 A to full reliability specifications
- High reliability

### Applications

- High Bay
- Roadway and Parking Area
- Outdoor Area Lighting
- Transportation
- Wide Area Lighting
- Architectural Lighting
- High Intensity General Lighting



*PhlatLight® LEDs enable a new class of illumination applications.*

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## Technology Overview

PhlatLight LEDs benefit from a suite of innovations in the fields of chip technology, packaging, and thermal management. These breakthroughs allow illumination designers to achieve efficient light engine designs and deliver high brightness solutions.

### PhlatLight Technology

The name PhlatLight is derived from Photonic Lattice. Photonic lattice technology creates true surface emission from the source, which enables large area LED chips with uniform brightness over the entire LED chip surface. The optical power and brightness produced by these large monolithic chips enable solutions which replace arc and halogen lamps where arrays of traditional high power LEDs cannot.

### Packaging Technology

Thermal management is critical in high power LED applications. With a thermal resistance from junction to heat sink of 0.90 °C/W, PhlatLight CSM-360 devices have the lowest thermal resistance of any LED on the market. This allows the LED to be driven at higher current densities while maintaining a low junction temperature, thereby resulting in brighter and longer lifetimes. The package is easy to use, and ready to be mounted in the lighting system.

### Reliability

Designed from the ground up, PhlatLight LEDs are one of the most reliable light sources in the world today. PhlatLight LEDs have passed a rigorous suite of environmental and mechanical stress tests, including mechanical shock, vibration, temperature cycling and humidity, and have been fully qualified for use in extreme high power and high current applications. With very low failure rates and median lifetimes that are well above 60,000 hours, PhlatLight LEDs are ready for the most demanding applications.

### Environmental Benefits

PhlatLight LEDs help reduce power consumption and the amount of hazardous waste entering the environment. All PhlatLight products manufactured by Luminus are RoHS compliant and free of hazardous materials, including lead and mercury.

## Understanding PhlatLight Test Specifications

Every PhlatLight LED device is fully tested to ensure that it meets the high quality standards of Luminus' products.

### Multiple Operating Points (3.15 A, 6.3 A)

The tables on the following pages provide typical optical and electrical characteristics. Since the LEDs can be operated over a wide range of drive conditions (currents from less than 1 A to 6.3 A, and duty cycle from <1% to 100%) multiple drive conditions are listed.

PhlatLight CSM-360 devices are production tested at 3.15 A. The values shown at 6.3 A are for additional reference at other possible drive conditions.

### PhlatLight White Binning Structure

PhlatLight White LEDs are tested for luminous flux and chromaticity at a drive current of 3.15 A and placed into one of the following luminous flux (FF) and chromaticity (WW) bins:

For ordering information, please refer to page 14 or PDS-001393: PhlatLight Binning and Labeling.

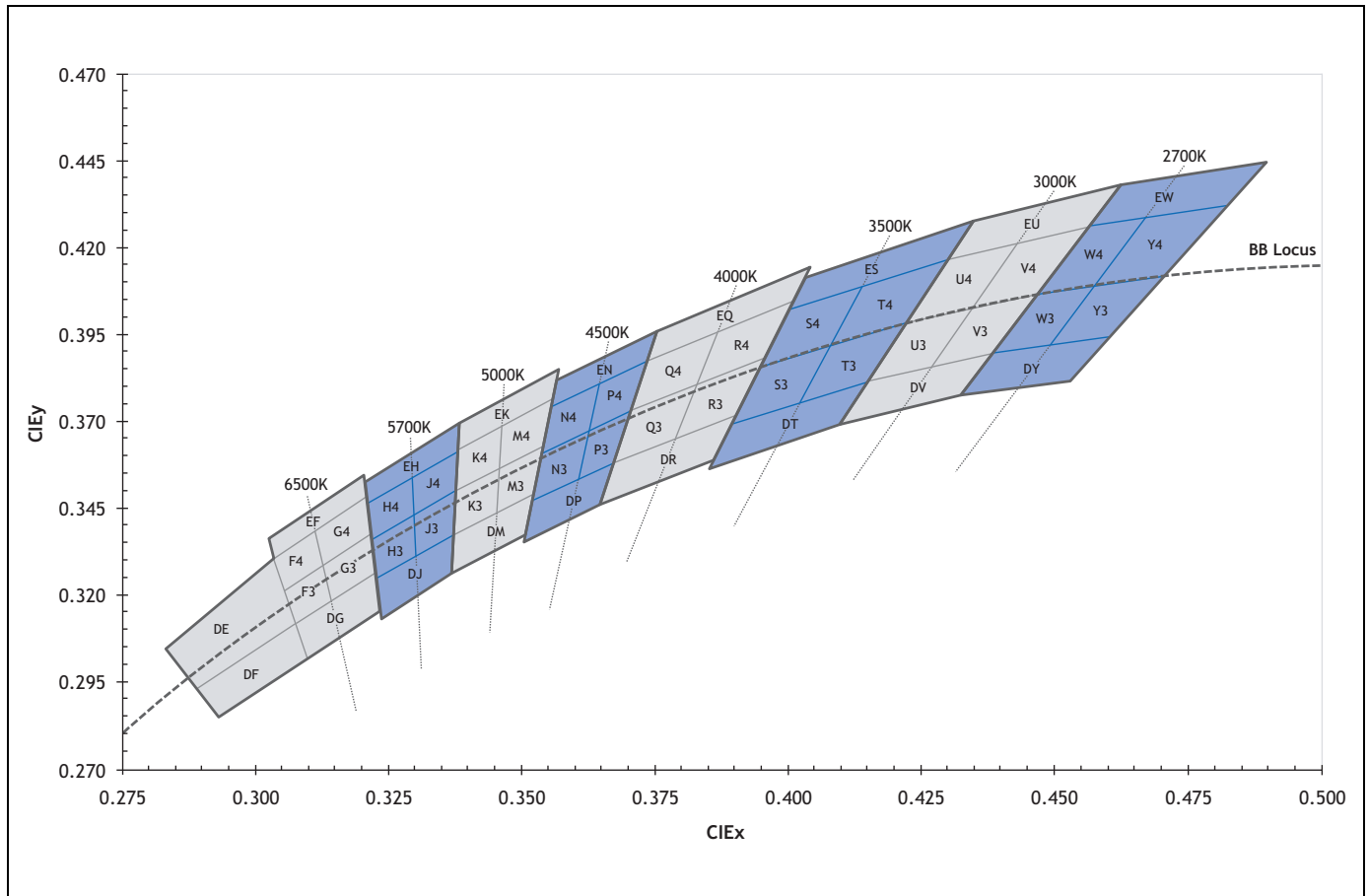
#### Flux Bins ( $T_J = 25\text{ }^{\circ}\text{C}$ )

| Color                                         | Flux Bin (FF) | Minimum Flux (lm)<br>@ 3.15 A | Maximum Flux (lm)<br>@ 3.15 A |
|-----------------------------------------------|---------------|-------------------------------|-------------------------------|
| <b>W65S</b><br>6500K, Standard CRI (typ. 70)  | WU            | 2,500                         | 3,000                         |
|                                               | WV            | 3,000                         | 3,600                         |
|                                               | WX            | 3,600                         | 4,300                         |
| <b>W57S</b><br>5700K, Standard CRI (typ. 70)  | WU            | 2,500                         | 3,000                         |
|                                               | WV            | 3,000                         | 3,600                         |
|                                               | WX            | 3,600                         | 4,300                         |
| <b>W45S</b><br>4500K, Standard CRI, (typ. 70) | WU            | 2,500                         | 3,000                         |
|                                               | WV            | 3,000                         | 3,600                         |
|                                               | WX            | 3,600                         | 4,300                         |
| <b>W30M</b><br>3000K, Moderate CRI, (typ. 83) | WS            | 1,750                         | 2,100                         |
|                                               | WT            | 2,100                         | 2,500                         |

•Note: Luminus maintains a tolerance of +/- 6% on flux measurements.

## Chromaticity Bins

Luminus' Standard Chromaticity Bins: 1931 CIE Curve



The following tables describe the four chromaticity points that bound each chromaticity bin. Chromaticity bins are grouped together based on the color temperature.

| 6500K Chromaticity Bins |       |       |
|-------------------------|-------|-------|
| Bin Code (WW)           | CIEx  | CIEy  |
| DG                      | 0.307 | 0.311 |
|                         | 0.322 | 0.326 |
|                         | 0.323 | 0.316 |
|                         | 0.309 | 0.302 |
| F3*                     | 0.305 | 0.321 |
|                         | 0.313 | 0.329 |
|                         | 0.315 | 0.319 |
|                         | 0.307 | 0.311 |
| F4*                     | 0.303 | 0.330 |
|                         | 0.312 | 0.339 |
|                         | 0.313 | 0.329 |
|                         | 0.305 | 0.321 |
| G3*                     | 0.313 | 0.329 |
|                         | 0.321 | 0.337 |
|                         | 0.322 | 0.326 |
|                         | 0.315 | 0.319 |
| G4*                     | 0.312 | 0.339 |
|                         | 0.321 | 0.348 |
|                         | 0.321 | 0.337 |
|                         | 0.313 | 0.329 |
| EF                      | 0.302 | 0.335 |
|                         | 0.320 | 0.354 |
|                         | 0.321 | 0.348 |
|                         | 0.303 | 0.330 |
| DE                      | 0.283 | 0.304 |
|                         | 0.303 | 0.330 |
|                         | 0.307 | 0.311 |
|                         | 0.289 | 0.293 |
| DF                      | 0.289 | 0.293 |
|                         | 0.307 | 0.311 |
|                         | 0.309 | 0.302 |
|                         | 0.293 | 0.285 |

| 5700K Chromaticity Bins |       |       |
|-------------------------|-------|-------|
| Bin Code (WW)           | CIEx  | CIEy  |
| DJ                      | 0.322 | 0.324 |
|                         | 0.337 | 0.337 |
|                         | 0.336 | 0.326 |
|                         | 0.323 | 0.314 |
| H3*                     | 0.321 | 0.335 |
|                         | 0.329 | 0.342 |
|                         | 0.329 | 0.331 |
|                         | 0.322 | 0.324 |
| H4*                     | 0.321 | 0.346 |
|                         | 0.329 | 0.354 |
|                         | 0.329 | 0.342 |
|                         | 0.321 | 0.335 |
| J3*                     | 0.329 | 0.342 |
|                         | 0.337 | 0.349 |
|                         | 0.337 | 0.337 |
|                         | 0.330 | 0.331 |
| J4*                     | 0.329 | 0.354 |
|                         | 0.338 | 0.362 |
|                         | 0.337 | 0.349 |
|                         | 0.329 | 0.342 |
| EH                      | 0.320 | 0.352 |
|                         | 0.338 | 0.368 |
|                         | 0.338 | 0.362 |
|                         | 0.321 | 0.346 |

| 5000K Chromaticity Bins |       |       |
|-------------------------|-------|-------|
| Bin Code (WW)           | CIEx  | CIEy  |
| EK                      | 0.338 | 0.368 |
|                         | 0.356 | 0.384 |
|                         | 0.355 | 0.376 |
|                         | 0.338 | 0.362 |
| K3*                     | 0.337 | 0.349 |
|                         | 0.345 | 0.355 |
|                         | 0.345 | 0.343 |
|                         | 0.337 | 0.337 |
| K4*                     | 0.338 | 0.362 |
|                         | 0.347 | 0.369 |
|                         | 0.345 | 0.355 |
|                         | 0.337 | 0.349 |
| M3*                     | 0.345 | 0.355 |
|                         | 0.353 | 0.362 |
|                         | 0.352 | 0.349 |
|                         | 0.344 | 0.343 |
| M4*                     | 0.346 | 0.369 |
|                         | 0.355 | 0.376 |
|                         | 0.353 | 0.362 |
|                         | 0.345 | 0.355 |
| DM                      | 0.337 | 0.337 |
|                         | 0.352 | 0.349 |
|                         | 0.350 | 0.337 |
|                         | 0.336 | 0.326 |

\* Sub-bins within ANSI defined quadrangles per ANSI C78.377-2008

| 4500k Chromaticity Bins |                  |                  |
|-------------------------|------------------|------------------|
| Bin Code (WW)           | CIE <sub>x</sub> | CIE <sub>y</sub> |
| EN                      | 0.356            | 0.384            |
|                         | 0.376            | 0.396            |
|                         | 0.374            | 0.387            |
|                         | 0.355            | 0.374            |
| N3*                     | 0.353            | 0.360            |
|                         | 0.361            | 0.366            |
|                         | 0.359            | 0.352            |
|                         | 0.351            | 0.347            |
| N4*                     | 0.355            | 0.374            |
|                         | 0.364            | 0.381            |
|                         | 0.361            | 0.366            |
|                         | 0.353            | 0.360            |
| P3*                     | 0.361            | 0.366            |
|                         | 0.370            | 0.373            |
|                         | 0.367            | 0.358            |
|                         | 0.359            | 0.352            |
| P4*                     | 0.364            | 0.381            |
|                         | 0.374            | 0.387            |
|                         | 0.370            | 0.373            |
|                         | 0.361            | 0.366            |
| DP                      | 0.351            | 0.347            |
|                         | 0.367            | 0.358            |
|                         | 0.364            | 0.346            |
|                         | 0.350            | 0.335            |

| 4000K Chromaticity Bins |                  |                  |
|-------------------------|------------------|------------------|
| Bin Code (WW)           | CIE <sub>x</sub> | CIE <sub>y</sub> |
| EQ                      | 0.376            | 0.396            |
|                         | 0.404            | 0.414            |
|                         | 0.401            | 0.404            |
|                         | 0.374            | 0.387            |
| Q3*                     | 0.370            | 0.373            |
|                         | 0.382            | 0.380            |
|                         | 0.378            | 0.365            |
|                         | 0.367            | 0.358            |
| Q4*                     | 0.374            | 0.387            |
|                         | 0.387            | 0.396            |
|                         | 0.382            | 0.380            |
|                         | 0.370            | 0.373            |
| R3*                     | 0.382            | 0.380            |
|                         | 0.395            | 0.388            |
|                         | 0.390            | 0.372            |
|                         | 0.378            | 0.365            |
| R4*                     | 0.387            | 0.396            |
|                         | 0.401            | 0.404            |
|                         | 0.395            | 0.388            |
|                         | 0.382            | 0.380            |
| DR                      | 0.367            | 0.358            |
|                         | 0.390            | 0.372            |
|                         | 0.386            | 0.359            |
|                         | 0.364            | 0.346            |

| 3500K Chromaticity Bins |                  |                  |
|-------------------------|------------------|------------------|
| Bin Code (WW)           | CIE <sub>x</sub> | CIE <sub>y</sub> |
| ES                      | 0.403            | 0.411            |
|                         | 0.435            | 0.427            |
|                         | 0.430            | 0.417            |
|                         | 0.400            | 0.402            |
| S3*                     | 0.394            | 0.385            |
|                         | 0.407            | 0.392            |
|                         | 0.402            | 0.375            |
|                         | 0.389            | 0.369            |
| S4*                     | 0.400            | 0.402            |
|                         | 0.415            | 0.409            |
|                         | 0.407            | 0.392            |
|                         | 0.394            | 0.385            |
| T3*                     | 0.407            | 0.392            |
|                         | 0.422            | 0.399            |
|                         | 0.415            | 0.381            |
|                         | 0.402            | 0.375            |
| T4*                     | 0.415            | 0.409            |
|                         | 0.430            | 0.417            |
|                         | 0.422            | 0.399            |
|                         | 0.407            | 0.392            |
| DT                      | 0.389            | 0.369            |
|                         | 0.415            | 0.381            |
|                         | 0.409            | 0.369            |
|                         | 0.385            | 0.357            |

| 3000K Chromaticity Bins |                  |                  |
|-------------------------|------------------|------------------|
| Bin Code (WW)           | CIE <sub>x</sub> | CIE <sub>y</sub> |
| EU                      | 0.435            | 0.427            |
|                         | 0.462            | 0.437            |
|                         | 0.456            | 0.426            |
|                         | 0.430            | 0.417            |
| U3*                     | 0.422            | 0.399            |
|                         | 0.434            | 0.403            |
|                         | 0.426            | 0.385            |
|                         | 0.415            | 0.381            |
| U4*                     | 0.430            | 0.417            |
|                         | 0.443            | 0.421            |
|                         | 0.434            | 0.403            |
|                         | 0.422            | 0.399            |
| V3*                     | 0.434            | 0.403            |
|                         | 0.447            | 0.408            |
|                         | 0.437            | 0.389            |
|                         | 0.426            | 0.385            |
| V4*                     | 0.443            | 0.421            |
|                         | 0.456            | 0.426            |
|                         | 0.447            | 0.408            |
|                         | 0.434            | 0.403            |
| DV                      | 0.415            | 0.381            |
|                         | 0.437            | 0.389            |
|                         | 0.431            | 0.377            |
|                         | 0.409            | 0.369            |

| 2700K Chromaticity Bins |                  |                  |
|-------------------------|------------------|------------------|
| Bin Code (WW)           | CIE <sub>x</sub> | CIE <sub>y</sub> |
| EW                      | 0.462            | 0.437            |
|                         | 0.488            | 0.444            |
|                         | 0.481            | 0.432            |
|                         | 0.456            | 0.426            |
| W3*                     | 0.447            | 0.408            |
|                         | 0.458            | 0.410            |
|                         | 0.448            | 0.392            |
|                         | 0.437            | 0.389            |
| W4*                     | 0.456            | 0.426            |
|                         | 0.469            | 0.429            |
|                         | 0.458            | 0.410            |
|                         | 0.447            | 0.408            |
| Y3*                     | 0.458            | 0.410            |
|                         | 0.470            | 0.413            |
|                         | 0.459            | 0.394            |
|                         | 0.448            | 0.392            |
| Y4*                     | 0.469            | 0.429            |
|                         | 0.481            | 0.432            |
|                         | 0.470            | 0.413            |
|                         | 0.458            | 0.410            |
| DY                      | 0.437            | 0.389            |
|                         | 0.459            | 0.394            |
|                         | 0.452            | 0.382            |
|                         | 0.431            | 0.377            |

\* Sub-bins within ANSI defined quadrangles per ANSI C78.377-2008

### PhlatLight Product Shipping and Labeling Information

All PhlatLight products are packaged and labeled with their respective bin as outlined in the tables on page 3. Modules are packaged in trays of 10, with each package only containing one bin. The part number designation is as follows:

**CSM** — **360** — **WNNX** — **D22** — **FF** — **WW**

| Product Family           | Chip Area               | Color                                 | Package Configuration | Flux Bin            | Chromaticity Bin    |
|--------------------------|-------------------------|---------------------------------------|-----------------------|---------------------|---------------------|
| CSM: Multi-Chip on Board | 360: 36 mm <sup>2</sup> | WNNX: CCT and CRI<br>See Note 1 Below | D22: 36 x 36 mm board | See page 3 for bins | See page 4 for bins |

Note 1. WNNX nomenclature corresponds to the following:

W = White

NN = color temperature, where:

65 corresponds to 6500K

40 corresponds to 4000K

30 corresponds to 3000K, etc.

X = color rendering index, where:

S (standard) corresponds to a typical CRI of 70

M (moderate) corresponds to a typical CRI of 83

H (high) corresponds to a typical CRI of 92.

Note 2. Some flux and chromaticity bins may have limited availability. Application specific bin kits, consisting of multiple bins, may be available. For ordering information, please refer to page 14 and reference PDS-001393: PhlatLight Binning and Labeling document.

Example: The part label CSM-360-W65S-D22-WS-G4 refers to a 6500K standard CRI white, CSM-360 module, D22 package configuration, with a minimum flux value of 2,100 to 2,500 lumens and a chromaticity value within the box defined by the four points (0.313, 0.338), (0.321, 0.348), (0.322, 0.336), (0.312, 0.328).

Example: The part label CSM-360-W30M-D22-WQ-U3 refers to a 3000K moderate CRI white, CSM-360 module, D22 package configuration, with a flux range of 1,450 to 1,750 lumens and a chromaticity value within the box defined by the four points (0.422, 0.399), (0.434, 0.403), (0.426, 0.386), (0.415, 0.381).

Optical and Electrical Characteristics ( $T_J = 25\text{ }^{\circ}\text{C}$ )

| Cool White                   |                    |                                                  |                         |                   |
|------------------------------|--------------------|--------------------------------------------------|-------------------------|-------------------|
| Drive Condition <sup>1</sup> |                    | 3.15A                                            | 6.3 A                   |                   |
| Parameter                    | Symbol             | Typical Values at Indicated Current <sup>2</sup> | Values at Test Currents | Unit              |
| Current Density              | j                  | 0.35                                             | 0.70                    | A/mm <sup>2</sup> |
| Forward Voltage              | V <sub>F-min</sub> | 11.00                                            |                         |                   |
|                              | V <sub>F</sub>     | 13.14                                            | 14.15                   | V                 |
|                              | V <sub>F-max</sub> | 17.60                                            |                         |                   |

## Common Characteristics

|                                                      | Symbol            | Values | Unit            |
|------------------------------------------------------|-------------------|--------|-----------------|
| Viewing Angle                                        | 2θ <sub>1/2</sub> | 115    | degrees         |
| Emitting Area                                        |                   | 36.0   | mm <sup>2</sup> |
| Emitting Area Dimensions                             |                   | 6 x 6  | mmxmm           |
| Forward Voltage Temperature Coefficient <sup>3</sup> |                   | -3.07  | mV/°C           |

## Absolute Maximum Ratings

|                                           | Symbol             | Values      | Unit |
|-------------------------------------------|--------------------|-------------|------|
| Maximum Current <sup>4</sup>              |                    | 6.3         | A    |
| Maximum Reverse Current                   |                    | Not Allowed | A    |
| Maximum Junction Temperature <sup>5</sup> | T <sub>J max</sub> | 150         | °C   |
| Storage Temperature Range                 |                    | -40/+100    | °C   |

Note 1: Listed drive conditions are typical for common applications. PhlatLight CSM-360 devices can be driven at currents ranging from <1 A to 6.3 A and at duty cycles ranging from 1% to 100%. Drive current and duty cycle should be adjusted as necessary to maintain the junction temperature desired to meet application lifetime requirements.

Note 2: Unless otherwise noted, values listed are typical.

Note 3: Forward voltage temperature coefficient at 3.15A. Contact Luminus for value at other drive conditions

Note 4: Luminus PhlatLight CSM-360-W LEDs are designed for operation to an absolute maximum forward drive current of 6.3 A. Product lifetime data is specified at recommended forward drive currents. Sustained operation at absolute maximum currents will result in a reduction of device lifetime compared to recommended forward drive currents. Actual device lifetimes will also depend on junction temperature. Refer to the reliability application Note for further information. In pulsed operation, rise time from 10-90% of forward current should be larger than 0.5 microseconds.

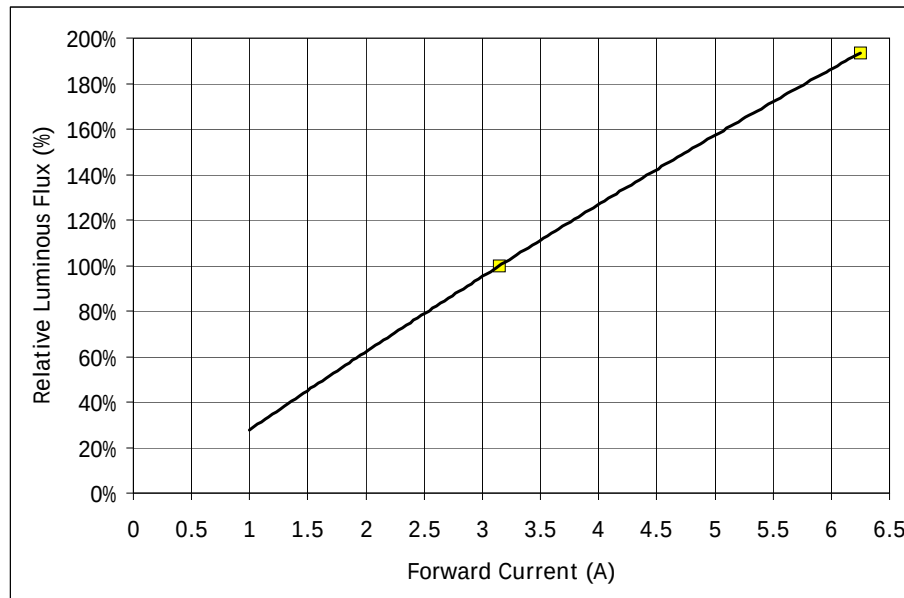
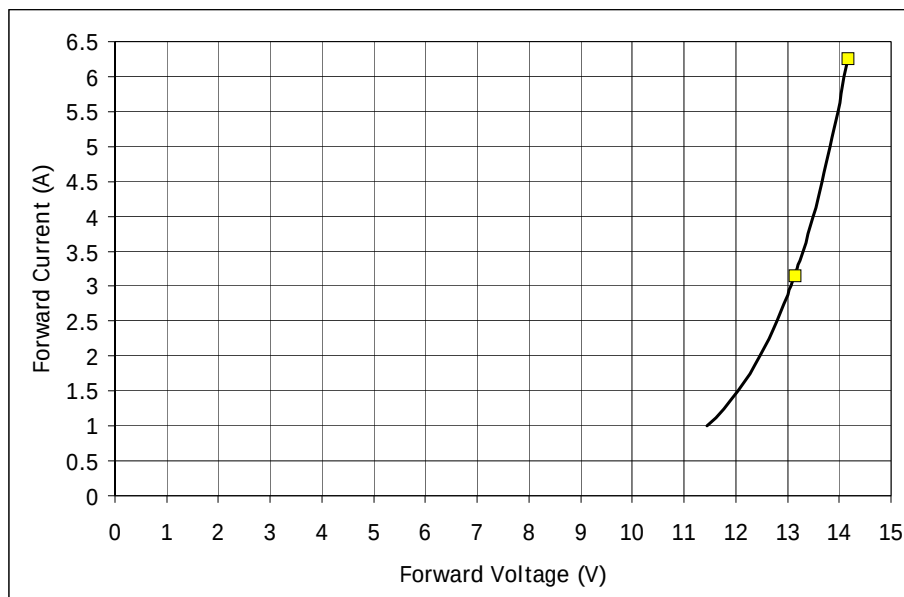
Note 5: Lifetime dependent on LED junction temperature. Input power and thermal system must be properly managed to ensure lifetime. See reliability application note for further information.

Note 6: CIE measurement uncertainty for white devices is estimated to be +/- 0.01.

Note 7: Special design considerations must be observed for operation under 1 A. Please contact Luminus for further information.

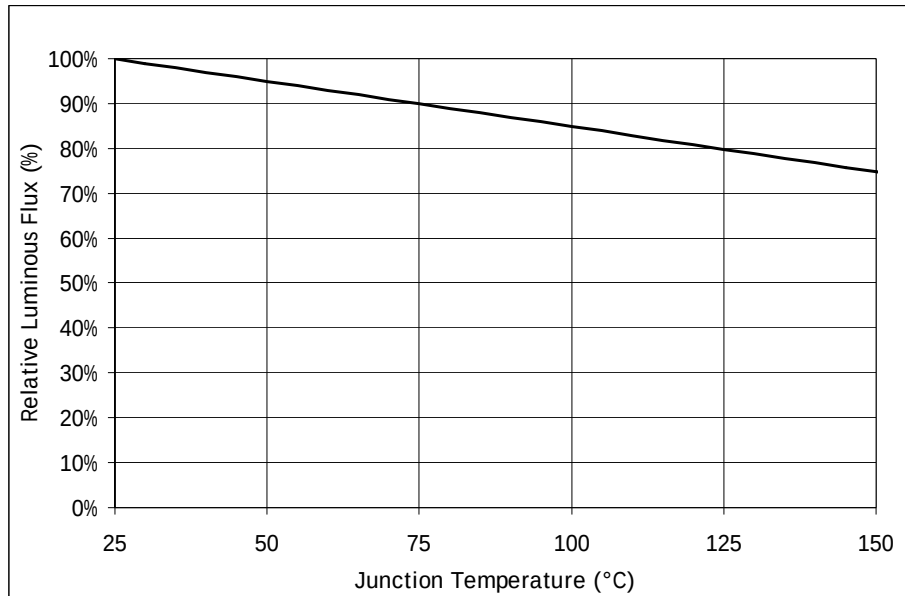
Note 8: Caution must be taken not to stare at the light emitted from these LEDs. Under special circumstances, the high intensity could damage the eye.



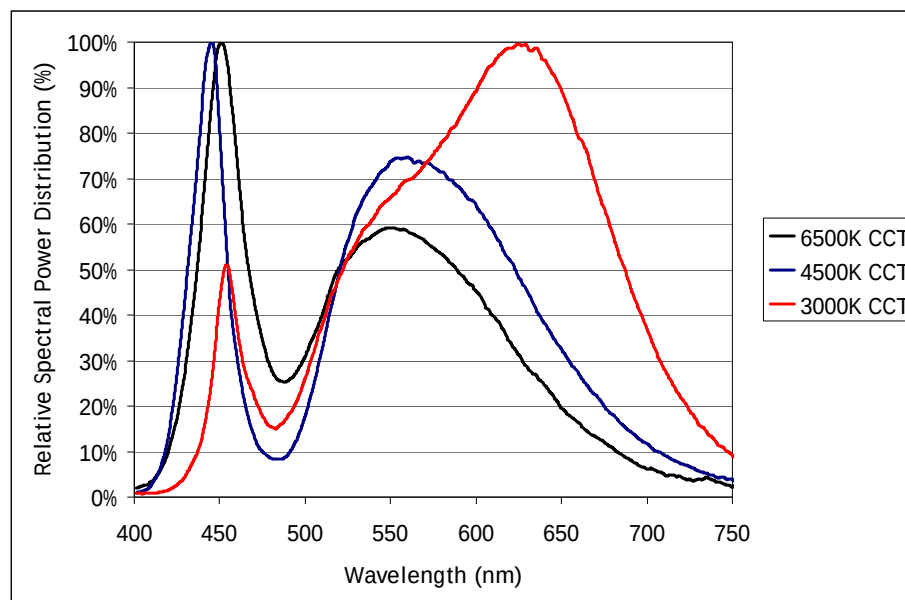
**Relative Luminous Flux vs. Forward Current ( $T_J = 25^\circ\text{C}$ )<sup>1</sup>****Forward Current vs. Forward Voltage ( $T_J = 25^\circ\text{C}$ )**

1. Yellow squares indicate typical operating conditions.

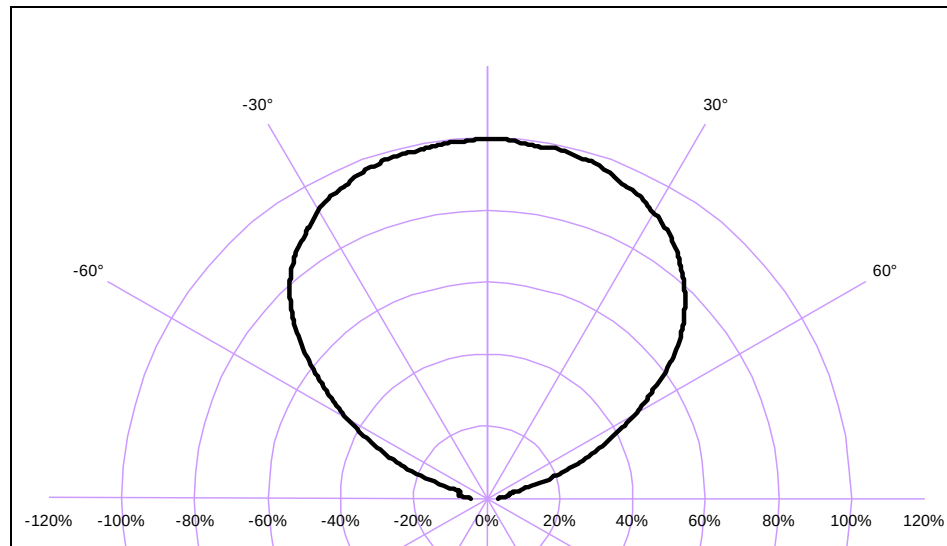
### Relative Luminous Flux vs. Junction Temperature ( $I_F = 3.15A$ )



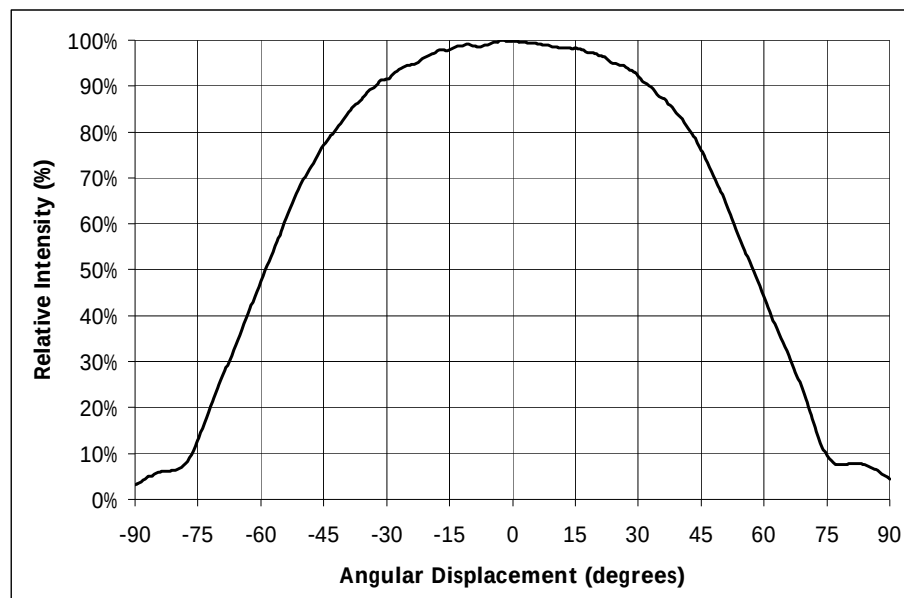
### Typical Relative Spectral Power ( $T_J = 25^\circ C$ )



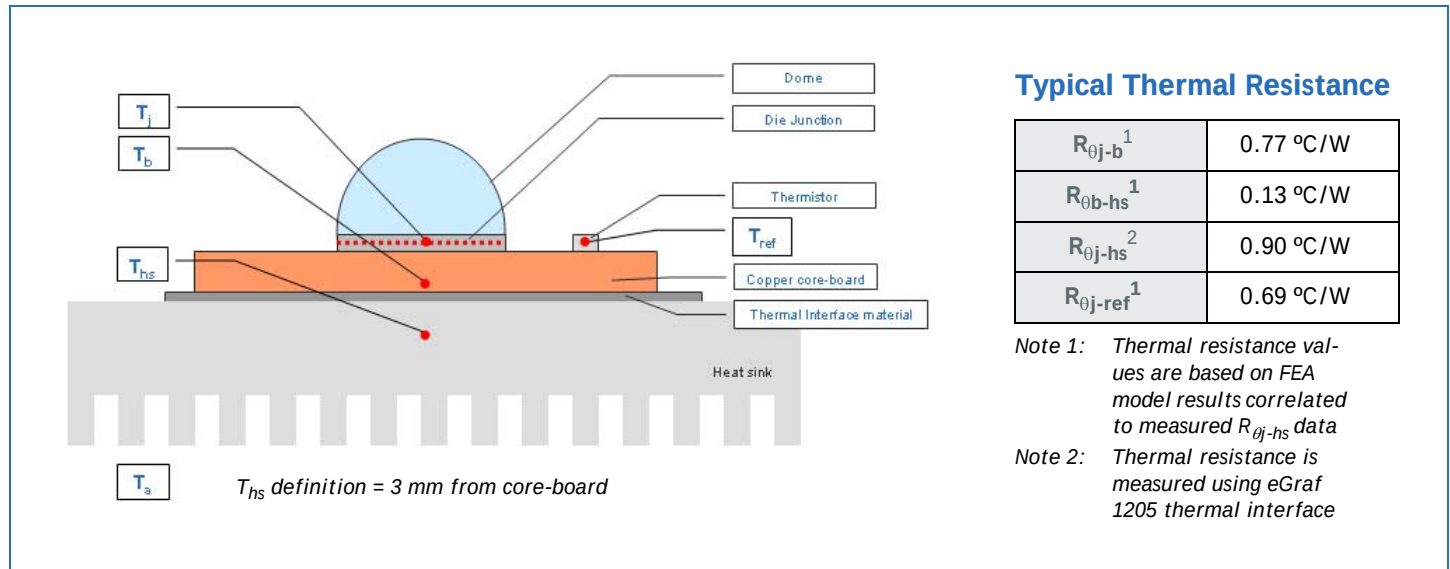
### Typical Polar Radiation Pattern



### Typical Angular Radiation Pattern



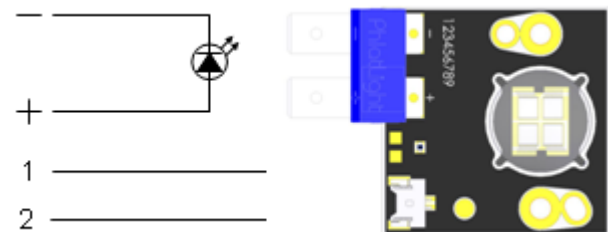
## Thermal Resistance



## Thermistor Information

The thermistor used in PhlatLight devices mounted on core-boards is from Murata Manufacturing Co. The global part number is NCP15XH103J03RC. Please see <http://www.murata.com/> for details on calculating thermistor temperature.

## Electrical Pinout



**DIMENSIONS IN MILLIMETERS**

The drawing includes the following views and dimensions:

- Top View:** Shows the overall footprint with a width of  $36.0 \pm 0.5$  mm and a height of 51 mm. It features two  $\phi 3.4$  fastener holes, two  $\phi 3.00^{+0.06}_{0.00}$  alignment holes, and a central lens area. Key horizontal dimensions include 27.95 mm, 27.06 mm, and 27.5 mm. Vertical dimensions include 5.50 mm, 10.76 mm, 11.24 mm, and 36.0  $\pm 0.5$  mm. A section line A-A is indicated.
- SECTION A-A:** A side cross-section showing the lens (B) with a diameter of  $\phi 16.00$  mm, the emitting area, and the coreboard. The total height is 3.18 mm, and the emitting area height is 5.61 [0.221] mm.
- DETAIL B:** A magnified view of the lens and emitting area, showing dimensions A, B, and C.

| DIMENSION NAME | DESCRIPTION                        | NOMINAL DIMENSION | TOLERANCE  |
|----------------|------------------------------------|-------------------|------------|
| "A"            | TOP OF SUBSTRATE TO TOP OF LENS    | 9.05              | $\pm 0.35$ |
| "B"            | EMITTING AREA TO TOP OF SUBSTRATE  | .47               | $\pm 0.05$ |
| "C"            | BOTTOM OF COREBOARD TO TOP OF LENS | 12.20             | $\pm 0.50$ |

Recommended connector for Anode and Cathode: Panduit Disco Lok™ Series P/N: DNG14-250FL-C  
 Thermistor Connector: MOLEX P/N 53780-0270. Recommended Female: MOLEX P/N 51146-0200 or equivalent

For detailed drawing please refer to DWG-001365 document

## Ordering Information

| Ordering Part Number <sup>1,2,3</sup> | Color                      | Description                                                                                                                                  |
|---------------------------------------|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| CSM-360-WDLS-D22-GT150                | 6500K White<br>5700K White | White PhlatLight CSM-360 consisting of four 9 mm <sup>2</sup> LEDs wired in series, thermistor, and connector, mounted on a copper-core PCB. |
| CSM-360-WCLS-D22-GT350                | 5000K White<br>4500K White | White PhlatLight CSM-360 consisting of four 9 mm <sup>2</sup> LEDs wired in series, thermistor, and connector, mounted on a copper-core PCB. |
| CSM-360-WWTM-D22-GR550                | 4000K White<br>3500K White | White PhlatLight CSM-360 consisting of four 9 mm <sup>2</sup> LEDs wired in series, thermistor, and connector, mounted on a copper-core PCB. |
| CSM-360-WWRM-D22-GR750                | 3000K White<br>2700K White | White PhlatLight CSM-360 consisting of four 9 mm <sup>2</sup> LEDs wired in series, thermistor, and connector, mounted on a copper-core PCB. |

Note 1: GT150 - denotes a bin kit comprising of all flux and chromaticity bins at the 6500K and 5700K color points

GT350 - denotes a bin kit comprising of all flux and chromaticity bins at the 5000K and 4500K color points

GR550 - denotes a bin kit comprising of all flux and chromaticity bins at the 4000K and 3500K color points

GR750 - denotes a bin kit comprising of all flux and chromaticity bins at the 3000K and 2700K color points

See PDS-001393: PhlatLight Binning and Labeling document for more information.

Note 2: For ordering information on all available bin kits, please see PDS-001393: PhlatLight Binning and Labeling document.

Note 3: Standard packaging increment (SPI) is 10.

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