

# PhlatLight<sup>®</sup> White LED Illumination Products

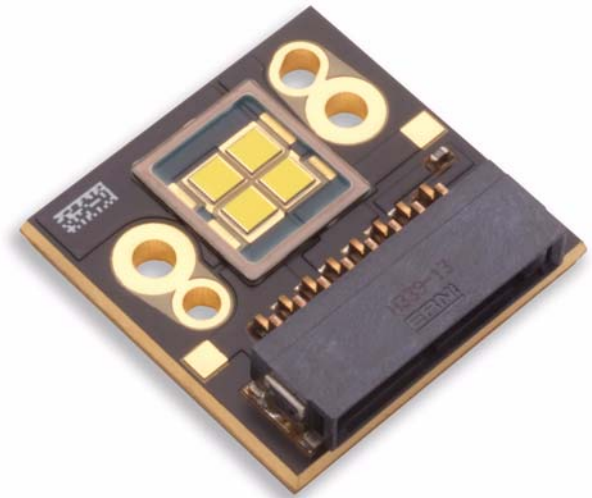
## CBM-360 Series

### Features

- Extremely high optical output: Over 4,500 lumens from a single package (White)
- High thermal conductivity package - junction to heat sink thermal resistance of only 0.96 °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

- Medical Lighting
- Machine Vision
- Microscopy
- Fiber Coupled Illumination
- Architectural Lighting
- Roadway and Parking Area
- Transportation



*PhlatLight<sup>®</sup> 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 0.96 °C/W, PhlatLight CBM-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.

### Testing Temperature

PhlatLight LEDs are measured in such a way that the characteristics reported agree with how the devices will actually perform when incorporated into a system. This measurement is accomplished by mounting the devices on a 40° C heat sink and allowing the device to reach thermal equilibrium while fully powered. Only after the device reaches equilibrium are the measurements taken. This method of measurement ensures that PhlatLight LEDs perform in the field just as they are specified.

### Multiple Operating Points (3.2 A, 6.3A)

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 <1 A to 6.3 A, and duty cycle from <1% to 100%) multiple drive conditions are listed.

PhlatLight CBM-360 devices are production tested at 6.3 A. The values shown at 3.2 A are for additional reference at other possible drive conditions.

### PhlatLight White Binning Structure

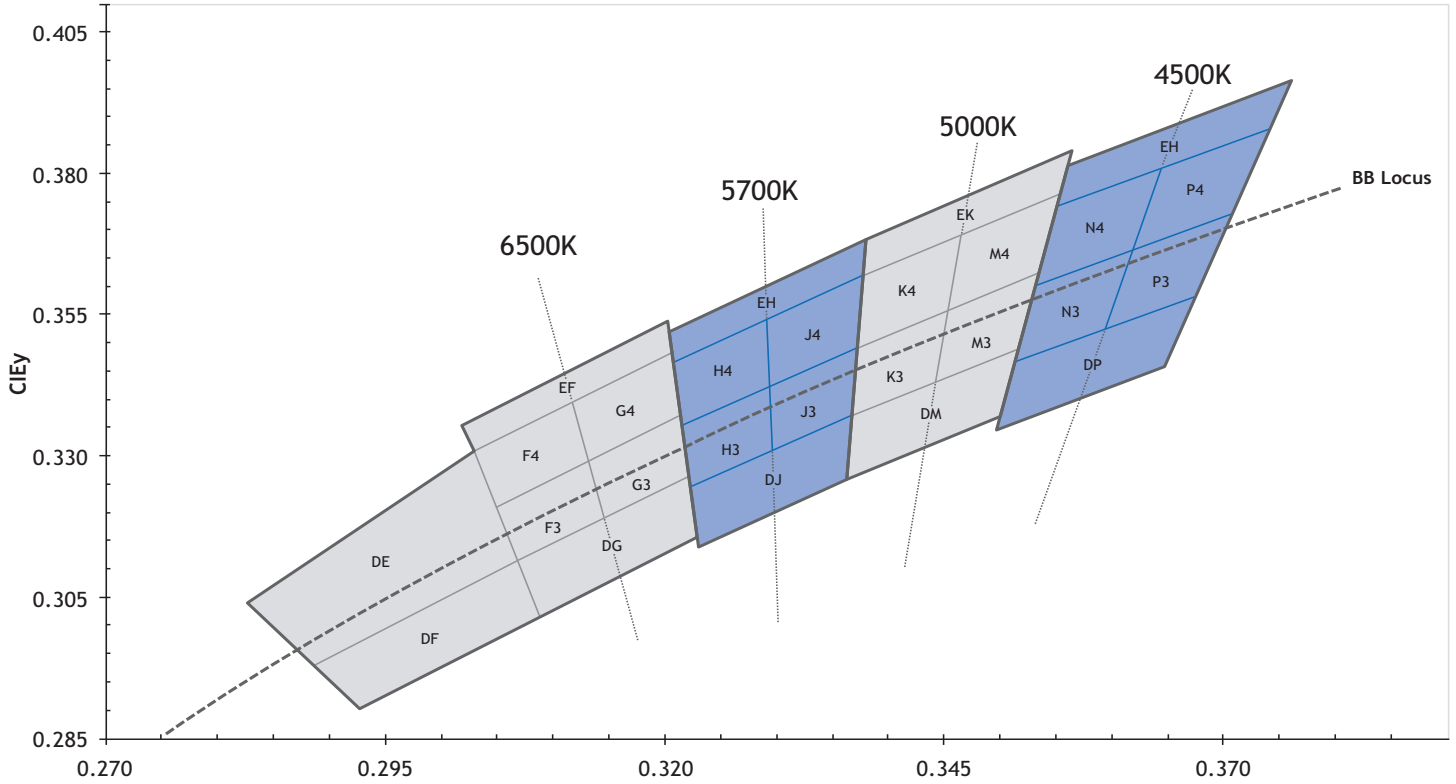
PhlatLight White LEDs are tested for luminous flux and chromaticity at a drive current of 6.3 A (0.70 A/mm<sup>2</sup>) and placed into one of the following luminous flux (FF) and chromaticity (WW) bins:

#### Flux Bins

| Color   | Flux Bin (FF) | Minimum Flux (lm)<br>@ 6.3 A | Maximum Flux (lm)<br>@ 6.3 A |
|---|---------------|------------------------------|------------------------------|
| <b>W65S</b><br>6500K, Standard CRI (typ. 70)  | WU            | 3,000                        | 3,600                        |
|   | WV            | 3,600                        | 4,300                        |
|   | WX            | 4,300                        | 5,100                        |
| <b>W57S</b><br>5700K, Standard CRI (typ. 70)  | WU            | 3,000                        | 3,600                        |
|   | WV            | 3,600                        | 4,300                        |
|   | WX            | 4,300                        | 5,100                        |
| <b>W50S</b><br>5000K, Standard CRI (typ. 70)  | WU            | 3,000                        | 3,600                        |
|   | WV            | 3,600                        | 4,300                        |
|   | WX            | 4,300                        | 5,100                        |
| <b>W45S</b><br>4500K, Standard CRI, (typ. 70) | WU            | 3,000                        | 3,600                        |
|   | WV            | 3,600                        | 4,300                        |
|   | WX            | 4,300                        | 5,100                        |

### Chromaticity Bins

Luminus' 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)           | CIE <sub>x</sub> | CIE <sub>y</sub> |
| 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)           | CIE <sub>x</sub> | CIE <sub>y</sub> |
| 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            |

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

| 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 |
| K4*                     | 0.337 | 0.337 |
|                         | 0.338 | 0.362 |
|                         | 0.347 | 0.369 |
|                         | 0.345 | 0.355 |
| M3*                     | 0.337 | 0.349 |
|                         | 0.345 | 0.355 |
|                         | 0.353 | 0.362 |
|                         | 0.352 | 0.349 |
| M4*                     | 0.344 | 0.343 |
|                         | 0.346 | 0.369 |
|                         | 0.355 | 0.376 |
|                         | 0.353 | 0.362 |
| DM                      | 0.345 | 0.355 |
|                         | 0.337 | 0.337 |
|                         | 0.352 | 0.349 |
|                         | 0.350 | 0.337 |
|                         | 0.336 | 0.326 |

| 4500k Chromaticity Bins |       |       |
|-------------------------|-------|-------|
| Bin Code (WW)           | CIEx  | CIEy  |
| 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 |

\* 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:

CBM — 360 — WNNX — D12 — FF — WW

| Product Family                   | Chip Area                 | Color                                 | Package Configuration | Flux Bin            | Chromaticity Bin    |
|----------------------------------|---------------------------|---------------------------------------|-----------------------|---------------------|---------------------|
| CBM: Window, Multi-Chip on Board | 360: 36.0 mm <sup>2</sup> | WNNX: CCT and CRI<br>See Note 1 Below | D12: 32 x 32 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

57 corresponds to 5700K

50 corresponds to 5000K

45 corresponds to 4500K

X = color rendering index, where:

S (standard) corresponds to a typical CRI of 70

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 12 and reference the PhlatLight Binning and Labeling document.

Example: The part label CBM-360-W65S-D12-WU-G4 refers to a 6500K standard CRI white, CBM-360 emitter, D12 package configuration, with a flux range of 3,000 to 3,600 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).

Optical and Electrical Characteristics at TrueTemp<sup>1</sup> ( $T_{\text{heat sink}} = 40\text{ }^{\circ}\text{C}$ )

| Cool White                   |                    |   |                            |                   |
|------------------------------|--------------------|---|----------------------------|-------------------|
| Drive Condition <sup>2</sup> |                    | 3.2A<br>Continuous                                  | 6.3 A<br>Continuous        |                   |
| Parameter                    | Symbol             | Typical Values at<br>Indicated Current <sup>3</sup> | Values at<br>Test Currents | Unit              |
| Current Density              | j                  | 0.35  | 0.70                       | A/mm <sup>2</sup> |
| Forward Voltage              | V <sub>F,min</sub> |   | 12.8                       | V                 |
|                              | V <sub>F,typ</sub> | 13.8  | 14.4                       | V                 |
|                              | V <sub>F,max</sub> |   | 16.0                       | V                 |

## Common Characteristics

|  | Symbol           | Values | Unit            |
|--|------------------|--------|-----------------|
| Emitting Area  |                  | 36.0   | mm <sup>2</sup> |
| Emitting Area Dimensions                             |                  | 6 x 6  | mmxmm           |
| Color Temperature <sup>4</sup>                       | CCT              | 6,500  | K               |
| Color Rendering Index                                | R <sub>a</sub>   | >70    |                 |
| Dynamic Resistance                                   | Ω <sub>dyn</sub> | 0.045  | Ω               |
| Forward Voltage Temperature Coefficient <sup>5</sup> |                  | -3.07  | mV/°C           |

## Absolute Maximum Ratings

|   |                    |          |    |
|---|--------------------|----------|----|
| Maximum Current <sup>6</sup>              |                    | 6.3      | A  |
| Maximum Junction Temperature <sup>7</sup> | T <sub>j max</sub> | 150      | °C |
| Storage Temperature Range                 |                    | -40/+100 | °C |

Note 1: All ratings are based on operation with a constant heat sink temperature  $T_{hs} = 40^{\circ}\text{C}$ . See Thermal Resistance section for  $T_{hs}$  definition.

Note 2: Listed drive conditions are typical for common applications. PhlatLight CBM-360-W devices can be driven at currents ranging from <1A to 6.3A 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 3: Unless otherwise noted, values listed are typical.

Note 4: CCT value based off of CIE measurement. CIE measurement uncertainty for white devices is estimated to be +/- 0.01.

Note 5: Forward voltage temperature coefficient at current density of 0.70 A/mm<sup>2</sup>. Contact Luminus for value at other drive conditions

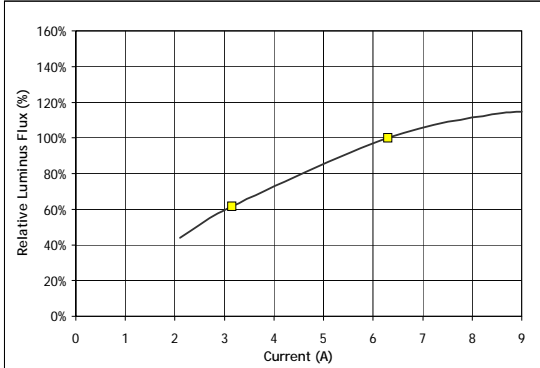
Note 6: Luminus PhlatLight CBM-360-W LEDs are designed for operation to an absolute maximum forward drive current density of 0.7 A/mm<sup>2</sup>. Product lifetime data is specified at recommended forward drive currents. Sustained operation beyond recommended drive current values will result in reduced life time. Thermal calculations should be performed to ensure T<sub>j</sub> is maintained below T<sub>jmax</sub> rating or device life will be reduced.

Note 7: Lifetime dependent on LED junction temperature. Input power and thermal system must be properly managed to ensure lifetime. See charts on pg 9 for further information.

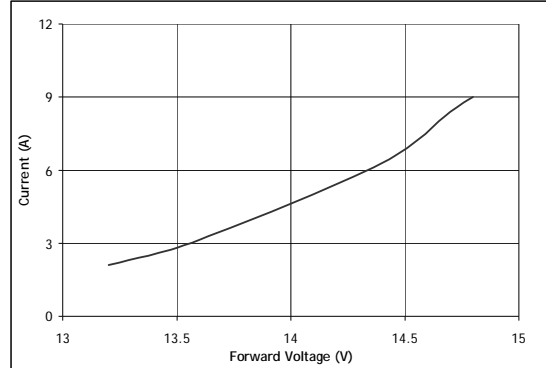
Note 8: Special design considerations must be observed for operation under 1 A. Please contact Luminus for further information.

Note 9: Caution must be taken not to stare at the light emitted from these LEDs. Under special circumstances, the high intensity could damage the eye.

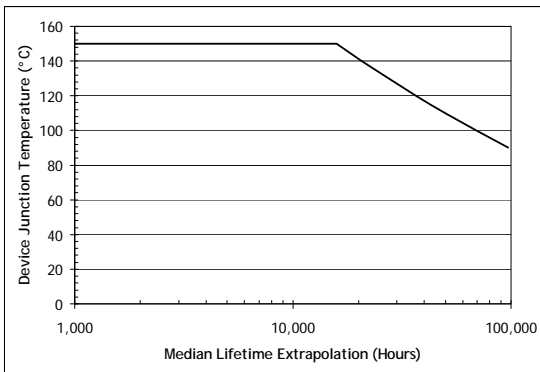
### Relative Output Flux vs. Forward Current<sup>1</sup>



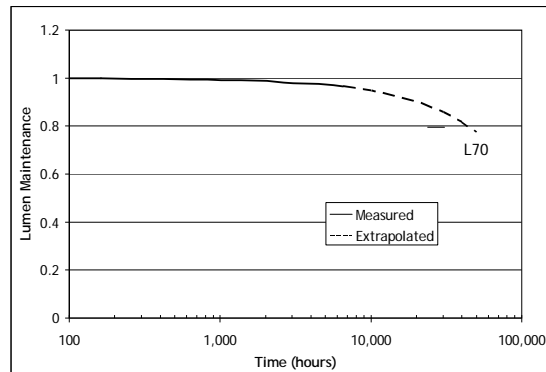
### Forward Current vs. Forward Voltage



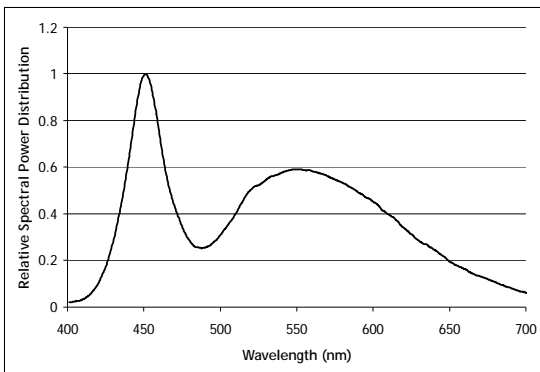
### Median Lifetime<sup>2</sup>



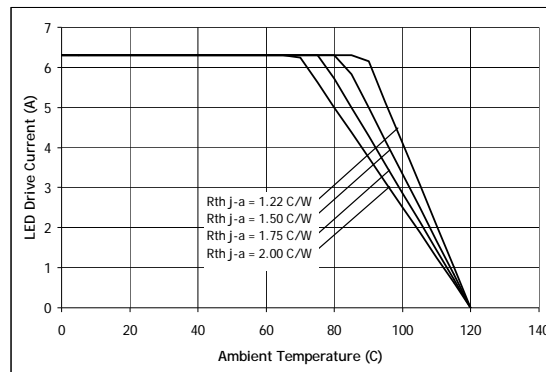
### Lumen Maintenance vs. Time<sup>3</sup>



### Typical Spectrum<sup>4</sup>



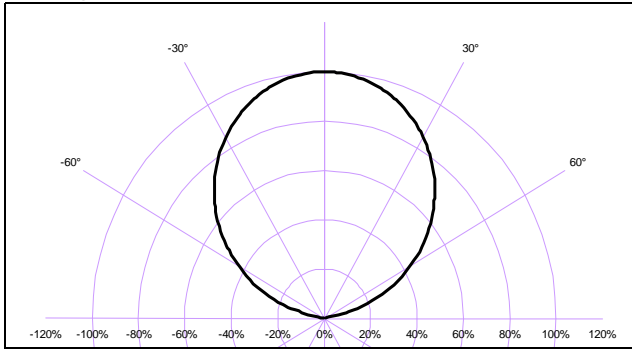
### Current Derating Curve



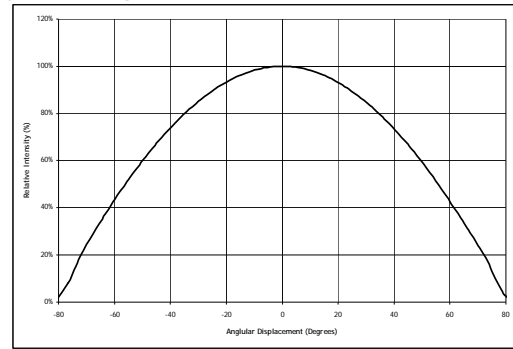
1. Yellow squares indicate typical operating conditions.
2. Median expected lifetime in dependence of junction temperature at 0.70 A/mm<sup>2</sup> in continuous operation. Lifetime defined as time to 70% of initial intensity. Data can be used to model failure rate over typical product lifetime.
3. Lumen maintenance in dependence of time at 0.70 A/mm<sup>2</sup> in continuous operation with junction temperatures of 100 °C.
4. Typical spectrum at current density of 0.70 A/mm<sup>2</sup> in continuous operation.

### Typical Radiation Pattern

Typical Polar Radiation Pattern for White



Typical Angular Radiation Pattern for White



### Thermal Resistance

|                      |           |
|----------------------|-----------|
| $R_{\theta j-b}^1$   | 0.83 °C/W |
| $R_{\theta b-hs}^1$  | 0.13 °C/W |
| $R_{\theta j-hs}^2$  | 0.96 °C/W |
| $R_{\theta j-ref}^1$ | 0.69 °C/W |

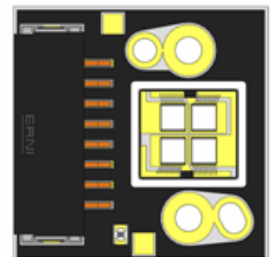
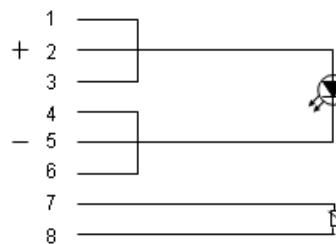
*Note 1: Thermal resistance values are based on FEA model results correlated to measured  $R_{\theta j-hs}$  data*

*Note 2: Thermal resistance is measured using eGraf 1205 thermal interface*

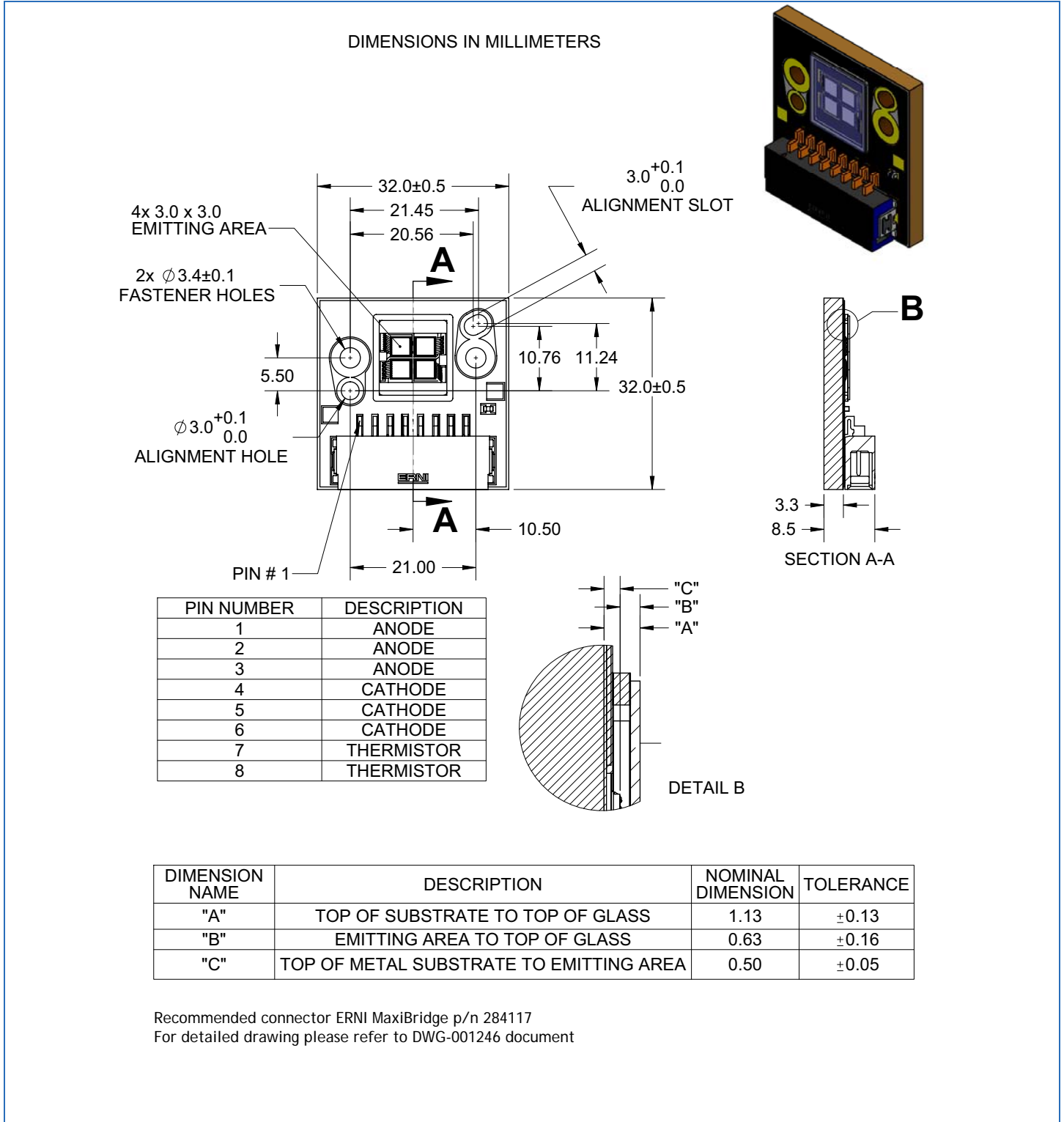
### Thermistor Information

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



Mechanical Dimensions



## Ordering Information

| Ordering Part Number <sup>1,2,3</sup> | Color                      | Description  |
|---------------------------------------|----------------------------|--|
| CBM-360-WDLS-D12-GU150                | 6500K White<br>5700K White | White PhlatLight CBM-360 consisting of four 9 mm <sup>2</sup> LEDs wired in series, thermistor, and connector, mounted on a copper-core PCB. |
| CBM-360-WCLSS-D12-GU350               | 5000K White<br>4500K White | White PhlatLight CBM-360 consisting of four 9 mm <sup>2</sup> LEDs wired in series, thermistor, and connector, mounted on a copper-core PCB. |

*Note 1: GU150 - denotes a bin kit comprising of all flux and chromaticity bins at the 6500K and 5700K color points*

*GU350 - denotes a bin kit comprising of all flux and chromaticity bins at the 5000K and 4500K color point*

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

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

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