

## CSM-360 LEDs



### Table of Contents

|                                                   |    |
|---------------------------------------------------|----|
| Technology Overview . . . . .                     | 2  |
| Test Specifications . . . . .                     | 2  |
| White Binning Structure . . . . .                 | 3  |
| Chromaticity Bins . . . . .                       | 4  |
| Product Shipping & Labeling Information . . . . . | 8  |
| Electrical Characteristics . . . . .              | 9  |
| Lifetime & Lumen Maintenance . . . . .            | 10 |
| Spectral Characteristics . . . . .                | 10 |
| Radiation Patterns . . . . .                      | 11 |
| Thermal Resistance . . . . .                      | 12 |
| Mechanical Dimensions . . . . .                   | 13 |
| Ordering Information . . . . .                    | 14 |

### Features:

- Extremely high optical output: Over 6,000 lumens from a single package (white)
- Extremely high efficiency: Over 100 lumens per watt at 3.15A
- High thermal conductivity package - junction to heat sink thermal resistance of only 0.90 °C/W
- Four large, monolithic chip 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
- High reliability

### Applications

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

## Technology Overview

Luminus Big Chip LEDs™ benefit from a suite of innovations in the fields of chip technology, packaging and thermal management. These breakthroughs allow illumination engineers and designers to achieve solutions that are high brightness and high efficiency.

### Photonic Lattice Technology

Luminus' photonic lattice technology 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.

For red, green and blue LEDs, the photonic lattice structures extract more light and create radiation patterns that are more collimated than traditional LEDs. Having higher collimation from the source increases optical collection efficiencies and simplifies optical designs.

### 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, Luminus CSM-360 LEDs 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 solutions

and longer lifetimes.

### Reliability

Designed from the ground up, Luminus Big Chip LEDs are one of the most reliable light sources in the world today. Big Chip 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 typically exceed 60,000 hours, Luminus Big Chip LEDs are ready for even the most demanding applications.

### Environmental Benefits

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

## Understanding Big Chip LED Test Specifications

Every Luminus LED is fully tested to ensure that it meets the high quality standards expected from Luminus' products.

### Testing Temperature

Luminus core board products are typically 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 Luminus Big Chip LEDs perform in the field just as they are specified.

Luminus surface mount LEDs are typically tested with a 20mSec input pulse and a junction temperature of 25°C. Expected flux values in real world operation can be extrapolated based on the information contained within this product data sheet.

### Multiple Operating Points (3.15, 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 1.0 A to 6.3 A, and duty cycle from <1% to 100%), multiple drive conditions are listed.

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

## CSM-360 White Binning Structure

CSM-360 LEDs are tested for luminous flux and chromaticity at a drive current of 3.15 A (350 mA/mm<sup>2</sup>) and placed into one of the following luminous flux (FF) and chromaticity (WW) bins:

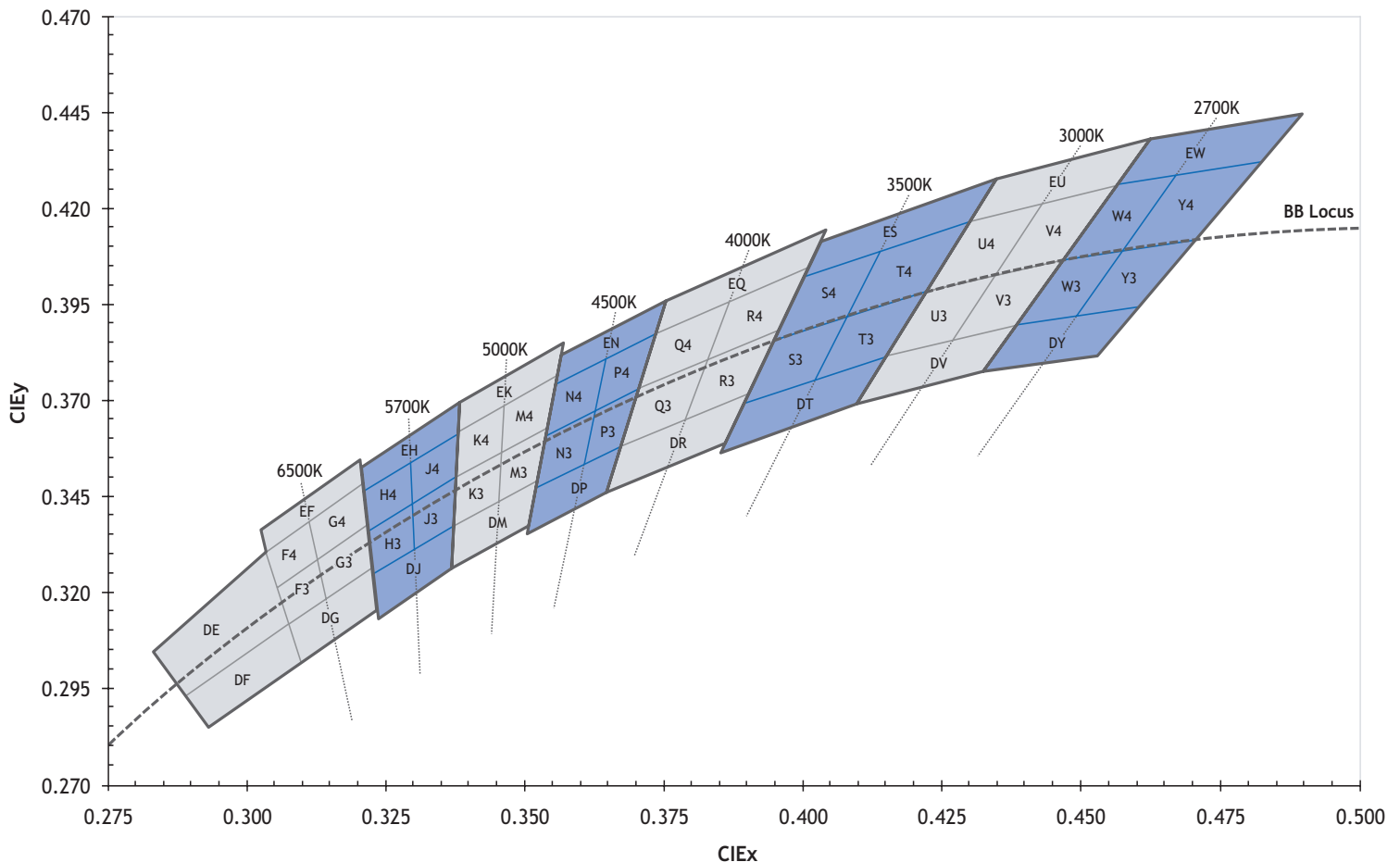
Flux Bins ( $T_j = 25\text{ }^{\circ}\text{C}$ )

| Flux Bin (FF) | Minumum Flux (lm) @ 3.15A | Maximum Flux (lm) @ 3.15A |
|---------------|---------------------------|---------------------------|
| S             | 1,750                     | 2,100                     |
| T             | 2,100                     | 2,500                     |
| U             | 2,500                     | 3,000                     |
| V             | 3,000                     | 3,600                     |
| X             | 3,600                     | 4,300                     |

\*Note: Luminus maintains a +/- 6% tolerance 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)           | 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)           | CIE <sub>x</sub> | CIE <sub>y</sub> |
| 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            | 0.349            |
|                         | 0.352            | 0.372            |
|                         | 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            |

| 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            |

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

| 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            |

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

| 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            |
|                         | 0.70             | 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

## Product Shipping & Labeling Information

All CSM-360 products are packaged and labeled with their respective bin as outlined in the tables from pages 3 to 6. When shipped, each package will only contain 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      |
|-------------------------|----------------------|-------------------------------|-----------------------|---------------------|-----------------------|
| Chip on Board<br>(Lens) | 36.0 mm <sup>2</sup> | CCT & CRI<br>See Note 1 below | Internal Code         | See page 3 for bins | See page 4-6 for bins |

Note 1: WNNX nomenclature corresponds to the following:

W = White

NN = color temperature, where:

65 corresponds to 6500K

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 14 and reference PDS-001850: CSM-360 Binning & Labeling document.

### Example:

The part number CSM-360-W65S-D22-GV-G4 refers to a 6500K standard CRI white, CSM-360 emitter, with a flux range from 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).

## Electrical Characteristics<sup>1</sup>

### Optical and Electrical Characteristics (T<sub>j</sub> = 25 °C)

| Drive Condition <sup>2</sup> |                     | 3.15 A                  | 6.3 A                                            |                   |
|------------------------------|---------------------|-------------------------|--------------------------------------------------|-------------------|
| Parameter                    | Symbol              | Values at Test Currents | Typical Values at Indicated Current <sup>3</sup> | Unit              |
| Current Density              | j                   | 0.35                    | 0.70                                             | A/mm <sup>2</sup> |
| Forward Voltage              | V <sub>F, min</sub> | 11.00                   |                                                  | V                 |
|                              | V <sub>F, typ</sub> | 13.14                   | 14.15                                            | V                 |
|                              | V <sub>F, max</sub> | 17.60                   |                                                  | V                 |

### Common Characteristics

| Parameter                                            | Symbol             | Values | Unit            |
|------------------------------------------------------|--------------------|--------|-----------------|
| Viewing Angle                                        | 2 θ <sub>1/2</sub> | 115    |                 |
| Emitting Area                                        |                    | 36.0   | mm <sup>2</sup> |
| Emitting Area Dimensions                             |                    | 6 x 6  | mm×mm           |
| Forward Voltage Temperature Coefficient <sup>4</sup> |                    | -3.07  | mV/°C           |

### Absolute Maximum Ratings

| Parameter                                 | Symbol             | Values   | Unit |
|-------------------------------------------|--------------------|----------|------|
| Maximum Current <sup>5</sup>              |                    | 6.3      | A    |
| Maximum Reverse Current                   |                    | N/A      |      |
| Maximum Junction Temperature <sup>6</sup> | T <sub>j-max</sub> | 150      | °C   |
| Storage Temperature Range                 |                    | -40/+100 | °C   |

Note 1: Listed drive conditions are typical for common applications. CSM-360 White 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 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: CSM-360 White devices are designed for operation to an absolute maximum forward drive current 6.3A. 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 Reliability Application Note for CSM-360-W for further information. In pulsed operation, rise time from 10-90% of forward current should be larger than 0.5 microseconds.

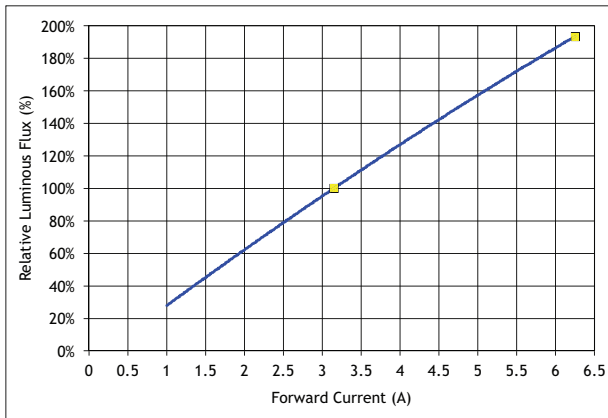
Note 5: Lifetime dependent on LED junction temperature. Thermal calculations based on input power and thermal management system should be performed to ensure T<sub>j</sub> is maintained below T<sub>j-max</sub> rating or life will be reduced. Refer to Reliability Application Note for further information.

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

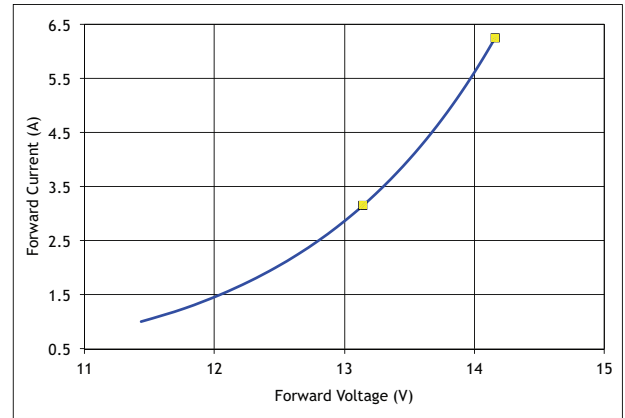
Note 7: Special design considerations must be observed for operation under 1A. Please contact Luminus for further information.

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.

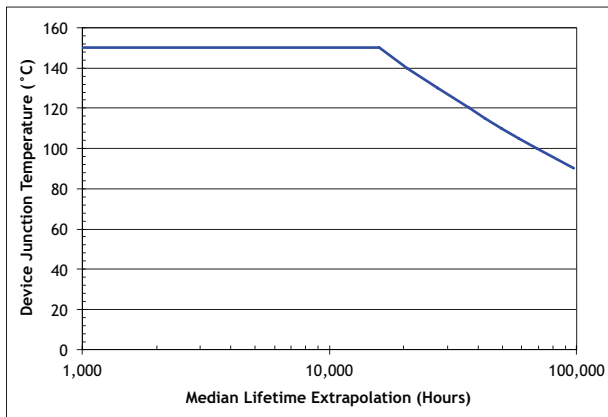
## Relative Output Flux vs. Forward Current<sup>1</sup>



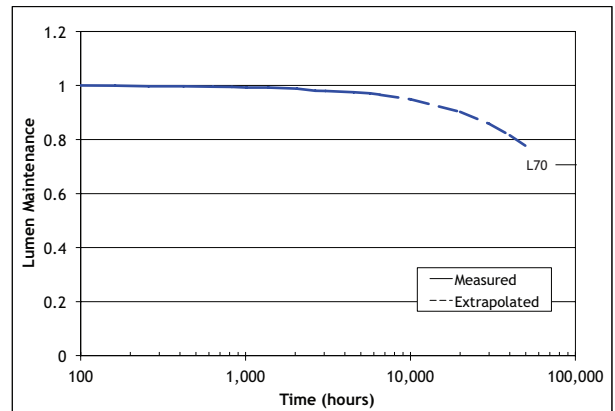
## Forward Current vs. Forward Voltage



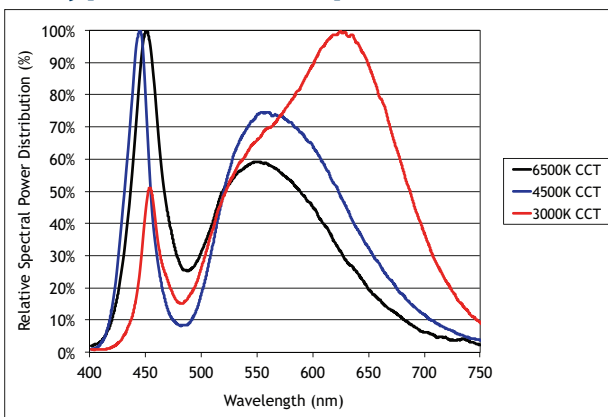
## Mean Lifetime<sup>2</sup>



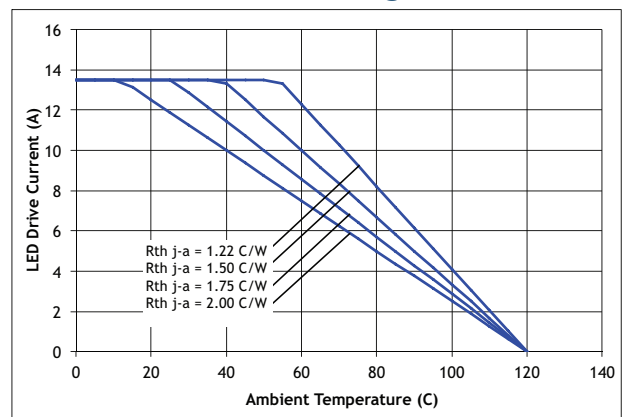
## Lumen Maintenance vs. Time<sup>3</sup>



## Typical Relative Spectral Power<sup>4</sup>



## Current Derating Curve



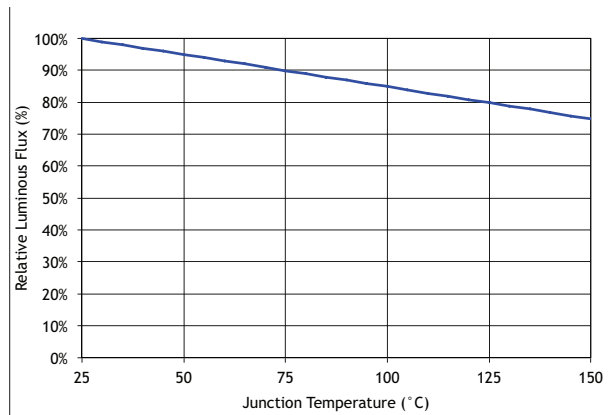
Note 1: Yellow squares indicate typical operating conditions.

Note 2: Mean expected lifetime in dependence of junction temperature at 0.35 A/mm<sup>2</sup> in continuous operation. Lifetime defined as time to 70% of initial intensity. Based on lifetime test data of uncoated GaN devices at this time. Data can be used to model failure rate over typical product lifetime (contact Luminus for lifetime reliability test data for 1A/mm<sup>2</sup> condition).

Note 3: Lumen maintenance in dependence of time at 0.35 A/mm<sup>2</sup> in continuous operation with junction temperatures of 100 °C.

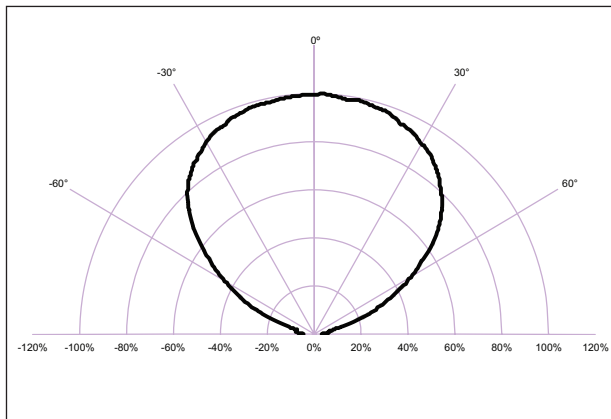
Note 4: Typical spectrum at current density of 0.35 A/mm<sup>2</sup> in continuous operation.

## Relative Flux vs. Junction Temperature

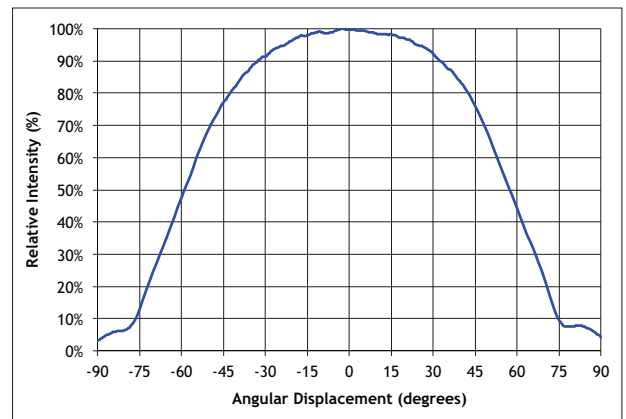


## Typical Radiation Patterns

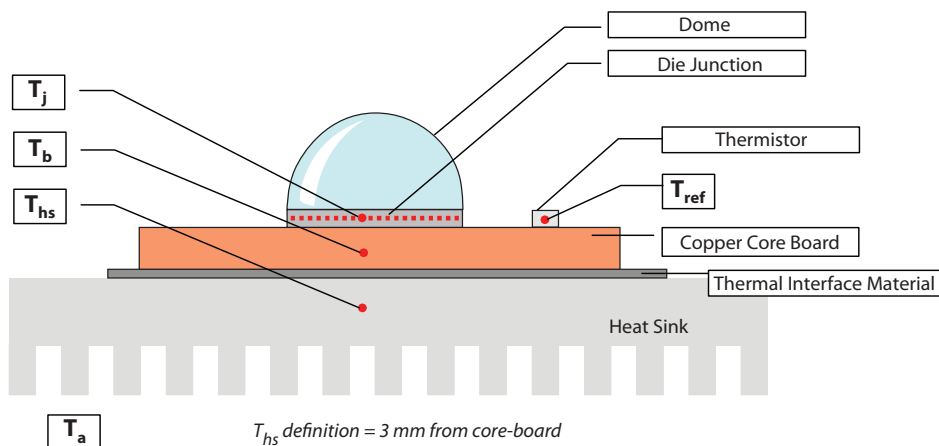
Typical Polar Radiation Pattern for White



Typical Angular Radiation Pattern for White



## Thermal Resistance



### Typical Thermal Resistance

|                      |           |
|----------------------|-----------|
| $R_{\theta j-b}^1$   | 0.77 °C/W |
| $R_{\theta b-hs}^1$  | 0.13 °C/W |
| $R_{\theta j-hs}^2$  | 0.90 °C/W |
| $R_{\theta j-ref}^1$ | 0.69 °C/W |

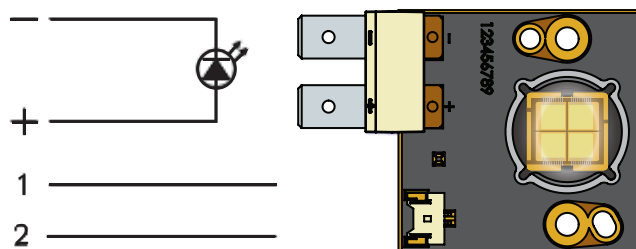
Note 1: Thermal resistance values are based on FEA model results correlated to measured  $R_{\theta j-hs}$  data.

Note 2: Thermal resistance is measured using a SAC305 solder, a Bergquist Al-clad MCPCB, and eGraf 1205 thermal interface material.

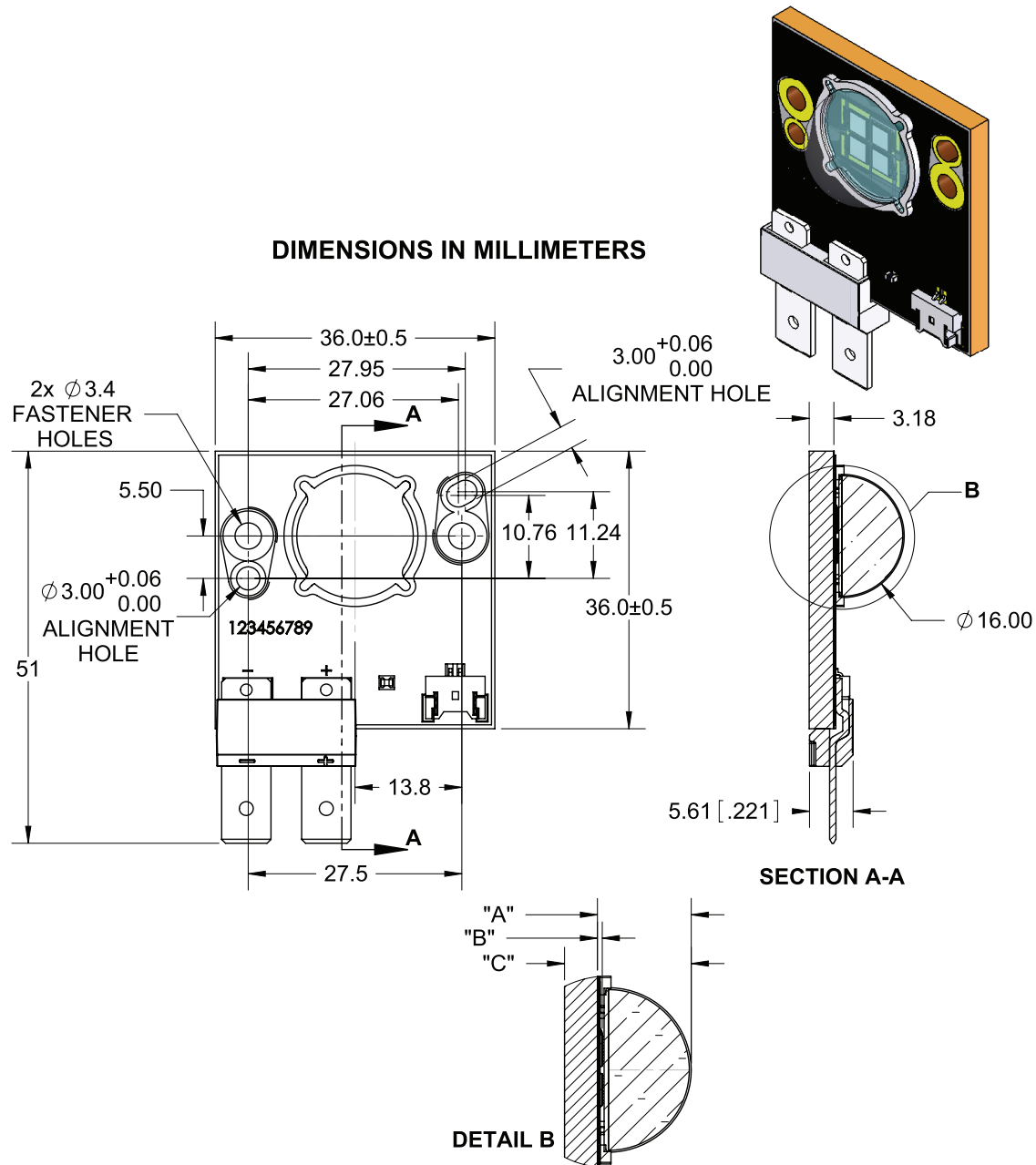
## Thermistor Information

The thermistor used in CSM-360 devices mounted on coreboards 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 – CSM-360 Emitter



| 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</sup> | Color                      | Description                                                                                                                         |
|-------------------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| CSM-360-WDLS-D22-GT150              | 6500K White<br>5700K White | White Big Chip LED™ CSM-360 consisting of four 9 mm <sup>2</sup> LEDs wired in series, thermistor, connector, and a copper-core PCB |
| CSM-360-WCLS-D22-GT450              | 4500K White<br>4000K White |                                                                                                                                     |
| CSM-360-WWRM-D22-GR750              | 3000K White<br>2700K White |                                                                                                                                     |

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

GT450 - denotes a bin kit comprising of all flux and chromaticity bins at the 4500K and 4000K color points.

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

Note 2: For ordering information on all available bin kits, please see PDS-001850: CSM-360 W Binning and Labeling document.

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

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Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

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