PRODUCT DATA SHEET

PRELIMINARY

PhlatLight® White LED Illumination Products

CSM-360 Series

PhlatLight® LEDs enable a new class of illumination applications.

Features

- Extremely high optical output: Over 6,000 lumens from a single package (White)
- Extremely high efficiency: Over 100 lumens per watt at 350 mA/mm^2
- High thermal conductivity package - junction to heat sink thermal resistance of only 0.90 ºC/W
- Four large, monolithic chips with uniform emitting area of 36 mm^2
- 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

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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 ºC/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 (3.2 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 3.2 A. The values shown at 6.3 A are for additional reference at other possible drive conditions.

PhlatLight White Binning Structure

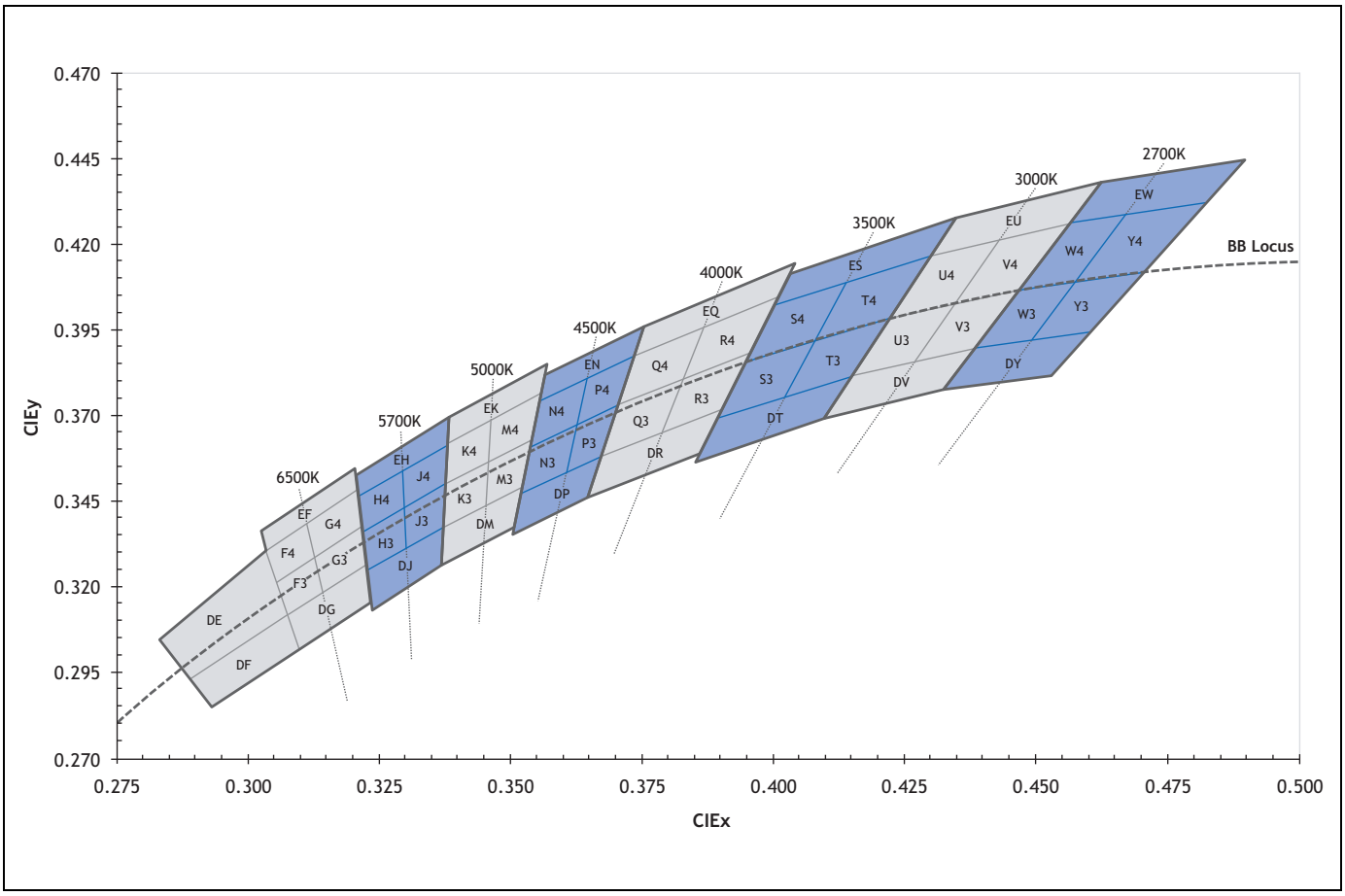
PhlatLight White LEDs are tested for luminous flux and chromaticity at a drive current of 3.2 A (0.35 A/mm^2) and placed into one of the following luminous flux (FF) and chromaticity (WW) bins:

Flux Bins

Color	Flux Bin (FF)	Minimum Flux (lm) @ 3.2 A	Maximum Flux (lm) @ 3.2 A
W65S 6500K, Standard CRI (typ. 70)	WS	2,100	2,500
	WT	2,500	3,000
	WU	3,000	3,600
	WV	3,600	4,300
W57S 5700K, Standard CRI (typ. 70)	WS	2,100	2,500
	WT	2,500	3,000
	WU	3,000	3,600
	WV	3,600	4,300
W45S 4500K, Standard CRI, (typ. 70)	WR	1,750	2,100
	WS	2,100	2,500
	WT	2,500	3,000
	WU	3,000	3,600
W40M 4000K, Moderate CRI, (typ. 83)	WR	1,750	2,100
	WS	2,100	2,500
	WT	2,500	3,000
	WU	3,000	3,600
W30M 3000K, Moderate CRI, (typ. 83)	WQ	1,450	1,750
	WR	1,750	2,100
	WS	2,100	2,500
	WT	2,500	3,000

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)	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

4000K Chromaticity Bins		
Bin Code (WW)	CIEx	CIEy
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)	CIEx	CIEy
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)	CIEx	CIEy
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)	CIEx	CIEy
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^2	WNNX: CCT and CRI 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 12 and reference the 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 minumum 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 [1]

Cool White				
Drive Condition[2]		**3.2A**	**6.3 A**	
Parameter	**Symbol**	**Typical Values at Indicated Current[3]**	**Values at Test Currents**	**Unit**
Current Density	j	0.35	0.70	A/mm^2
Forward Voltage	V_F	12.8	13.6	V

Common Characteristics

	Symbol	Values	Unit
Emitting Area		36.0	mm^2
Emitting Area Dimensions		6 x 6	mmxmm
Dynamic Resistance	Ω_{dyn}	0.045	Ω
Forward Voltage Temperature Coefficient[4]		-3.07	mV/ºC

Absolute Maximum Ratings

	Symbol	Values	Unit
Maximum Current[5]		6.3	A
Maximum Junction Temperature[6]	$T_{j\ max}$	150	ºC
Storage Temperature Range		-40/+100	ºC

Note 1: All ratings are based on test conditions of Tj=25C, 20 millisecond pulse. See Thermal Resistance section for T_j definition.

Note 2: 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 3: Unless otherwise noted, values listed are typical.

Note 4: Forward voltage temperature coefficient at current density of 0.70 A/mm^2. Contact Luminus for value at other drive conditions

Note 5: Luminus Phlatlight CSM-360 LEDs are designed for operation to an absolute maximum forward drive current density of 0.70 A/mm^2. 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 Tj is maintained below T_{jmax} rating or device life will be reduced.

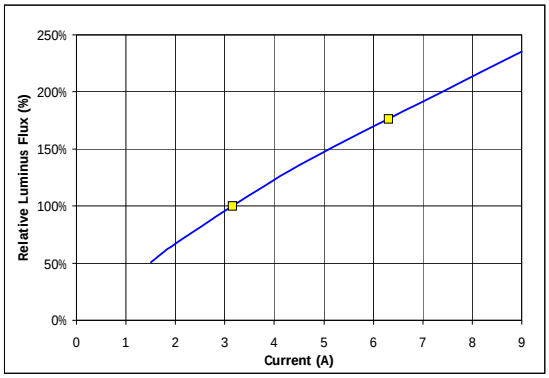
Note 6: Lifetime dependent on LED junction temperature. Input power and thermal system must be properly managed to ensure lifetime. See charts on pg 6 for further information.

Note 7: CIE measurement uncertainty for white devices is estimated to be +/- 0.01.

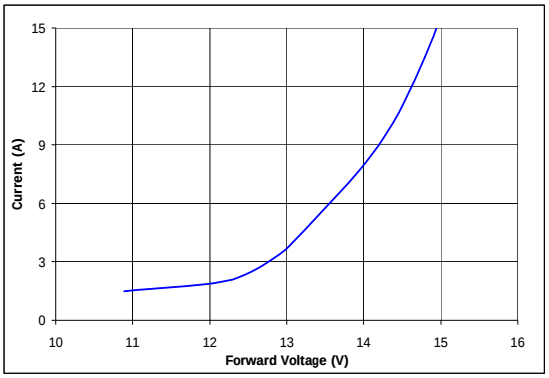
Note 8: Special design considerations must be observed for operation under 1 A. Please contact Luminus for further information.

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.

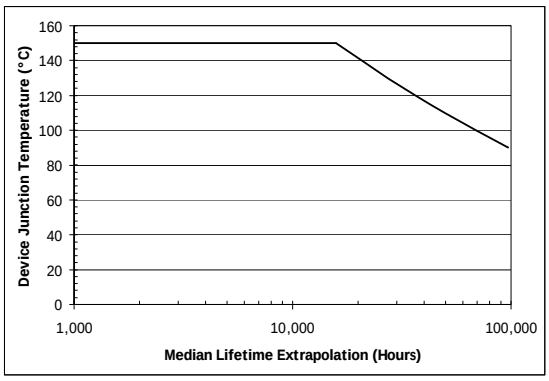
Relative Output Flux vs. Forward Current[1]



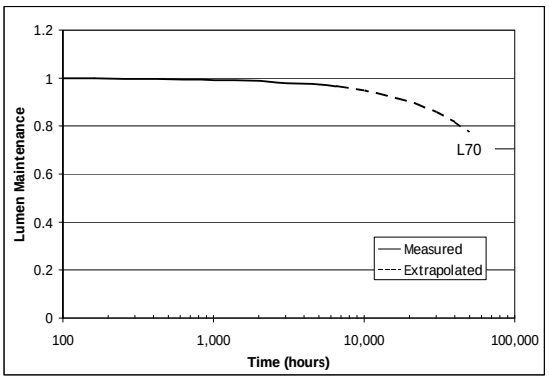
Forward Current vs. Forward Voltage



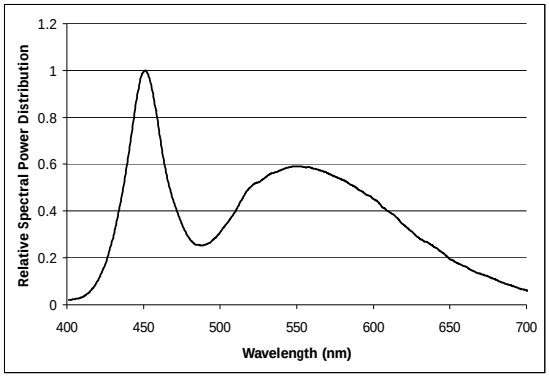
Mean Lifetime[2]



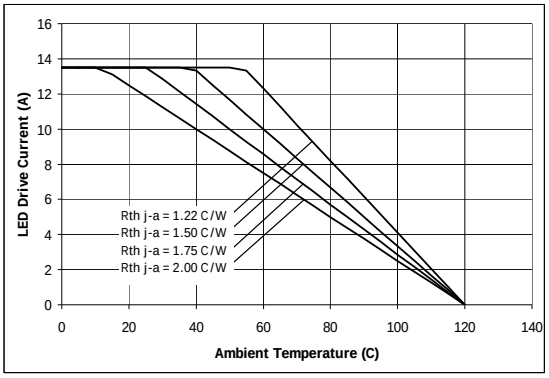
Lumen Maintenance vs. Time[3]



Typical Spectrum[4]



Current Derating Curve



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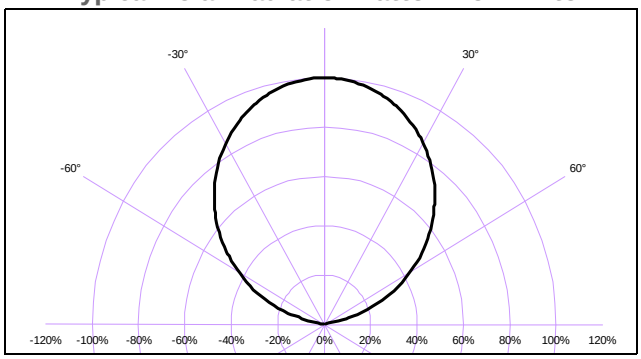
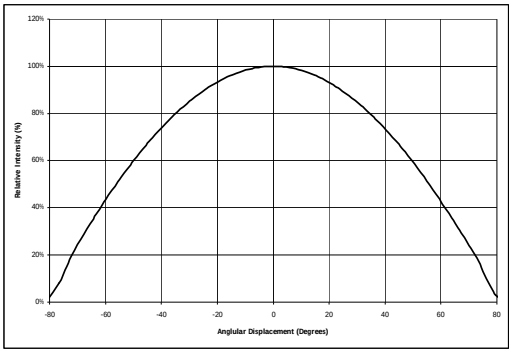
1. *Yellow squares indicate typical operating conditions.*
2. *Mean expected lifetime in dependence of junction temperature at 0.35A/mm^2 in continuous operation. Lifetime defined as time to 70% of initial intensity. Based on lifetime test data of uncoated GaN devices at this time. Data can be used to model failure rate over typical product lifetime.*
3. *Lumen maintenance in dependence of time at 0.35A/mm^2 in continuous operation with junction temperatures of 100 ^{o}C.*
4. *Typical spectrum at current density of 0.35 A/mm^2 in continuous operation.*

Typical Radiation Pattern

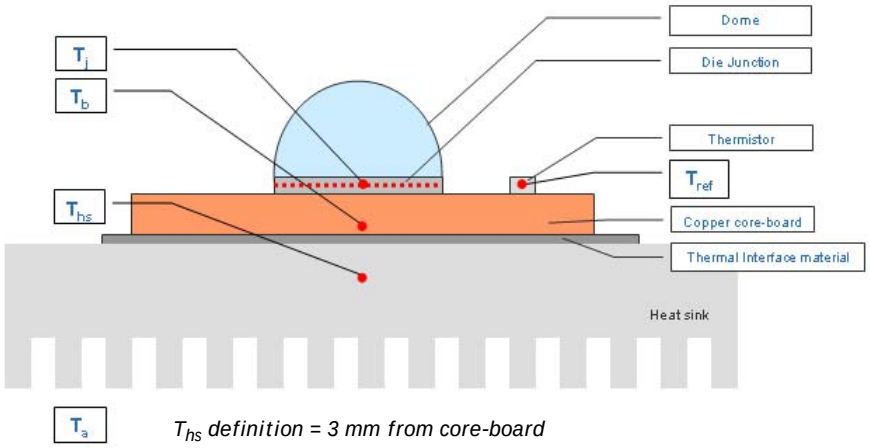
Typical Polar Radiation Pattern for White



Typical Angular Radiation Pattern for White



Thermal Resistance



T_{hs} *definition = 3 mm from core-board*

Typical Thermal Resistance

$R_{\theta j\text{-}b}$ [1]	0.77 ºC/W
$R_{\theta b\text{-}hs}$ [1]	0.13 ºC/W
$R_{\theta j\text{-}hs}$ [2]	0.90 ºC/W
$R_{\theta j\text{-}ref}$ [1]	0.69 ºC/W

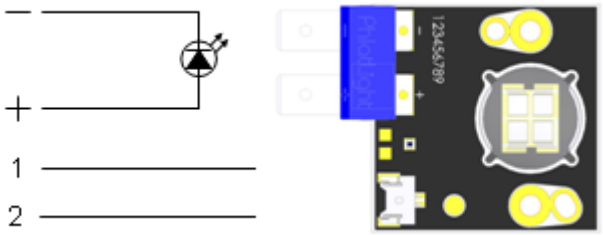
Note 1: Thermal resistance values are based on FEA model results correlated to measured $R_{\theta j\text{-}hs}$ data

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

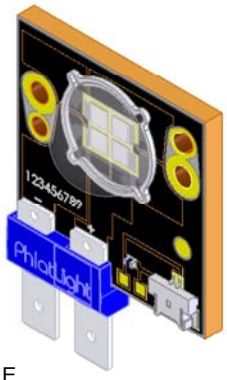
Thermistor Information

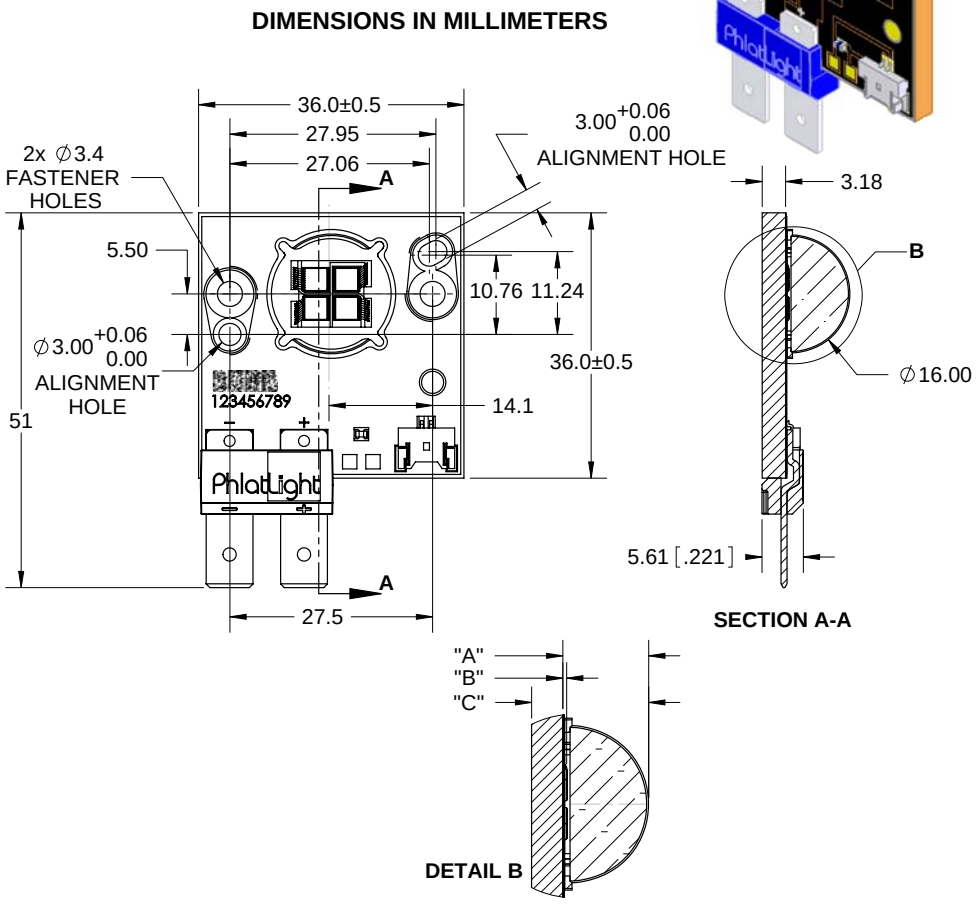
The thermistor used in PhlatLight devices mounted on core-boards is from Murata Manufacturing Co. The global part number is NCP15XH103J03RC. Please see http://www.murata.com/ for details on calculating thermistor temperature.

Electrical Pinout



Mechanical Dimensions





DIMENSION NAME	DESCRIPTION	NOMINAL DIMENSION	TOLERANCE
"A"	TOP OF SUBSTRATE TO TOP OF LENS	8.74	±0.35
"B"	EMITTING AREA TO TOP OF SUBSTRATE	0.39	±0.05
"C"	BOTTOM OF COREBOARD TO TOP OF LENS	11.91	±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[1,2,3]	Color	Description
CSM-360-W65S-D22-GS100	6500K White	White PhlatLight CSM-360 consisting of four 9 mm^2 LEDs wired in series, thermistor, and connector, mounted on a copper-core PCB.
CSM-360-W57S-D22-GS200	5700K White	White PhlatLight CSM-360 consisting of four 9 mm^2 LEDs wired in series, thermistor, and connector, mounted on a copper-core PCB.
CSM-360-W45S-D22-GR400	4500K White	White PhlatLight CSM-360 consisting of four 9 mm^2 LEDs wired in series, thermistor, and connector, mounted on a copper-core PCB.
CSM-360-W40M-D22-GR500	4000K White	White PhlatLight CSM-360 consisting of four 9 mm^2 LEDs wired in series, thermistor, and connector, mounted on a copper-core PCB.
CSM-360-W30M-D22-GQ700	3000K White	White PhlatLight CSM-360 consisting of four 9 mm^2 LEDs wired in series, thermistor, and connector, mounted on a copper-core PCB.

Note 1: GS100 - denotes a bin kit comprising of all flux and chromaticity bins at the 6500K color point
GS200 - denotes a bin kit comprising of all flux and chromaticity bins at the 5700K color point
GR400 - denotes a bin kit comprising of all flux and chromaticity bins at the 4500K color point
GR500 - denotes a bin kit comprising of all flux and chromaticity bins at the 4000K color point
GQ700 - denotes a bin kit comprising of all flux and chromaticity bins at the 3000K color point
See PhlatLight Binning and Labeling document for more information.
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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