

PhlatLight® LED Illumination Products

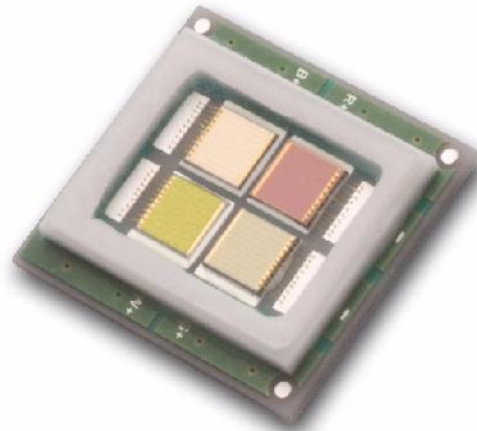
SBM-160 Series

Features

- Extremely high optical output:
 - up to 270 Red lumens
 - up to 640 Green lumens
 - up to 120 Blue lumens
 - up to 550 White lumens
- High thermal conductivity package - junction to heat sink thermal resistance as low as 1.48 °C/W per die
- Photonic lattice technology for very high surface brightness and uniform emission
- Four big chips with emitting area of up to 4 mm² each
- Environmentally friendly: RoHS compliant
- Variable drive currents: less than 1 A through 4 A to full reliability specifications
- Available in RGBW combination

Applications

- Entertainment
- Architectural Lighting
- Medical Lighting
- Spot Lighting
- Fiber Coupled Illumination
- Machine Vision
- Displays and Signage



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. PhlatLight devices use photonic lattice patterns to extract more light from the LED chip.

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.

In addition, PhlatLight technology can create radiation patterns that are collimated compared to typical Lambertian emitters. Optical collection efficiencies improve and optical designs become simplified with a more collimated light source.

Packaging Technology

Thermal management is critical in high power LED applications. With a thermal resistance from junction to heat sink of 1.48 °C/W per chip, PhlatLight SBM-160 devices have the lowest thermal resistance of any LED on the market. This allows operation 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.

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

The actual operating condition will depend upon the application, flux requirements, thermal design, and other detailed system parameters.

White Binning Structure
Flux Bins

Flux Bin Code (FF)	Minimum Luminous Flux @ $I_F = 4.0 \text{ A}$	Maximum Luminous Flux @ $I_F = 4.0 \text{ A}$
DA	440	475
DB	475	510
EA	510	550
EB	550	590

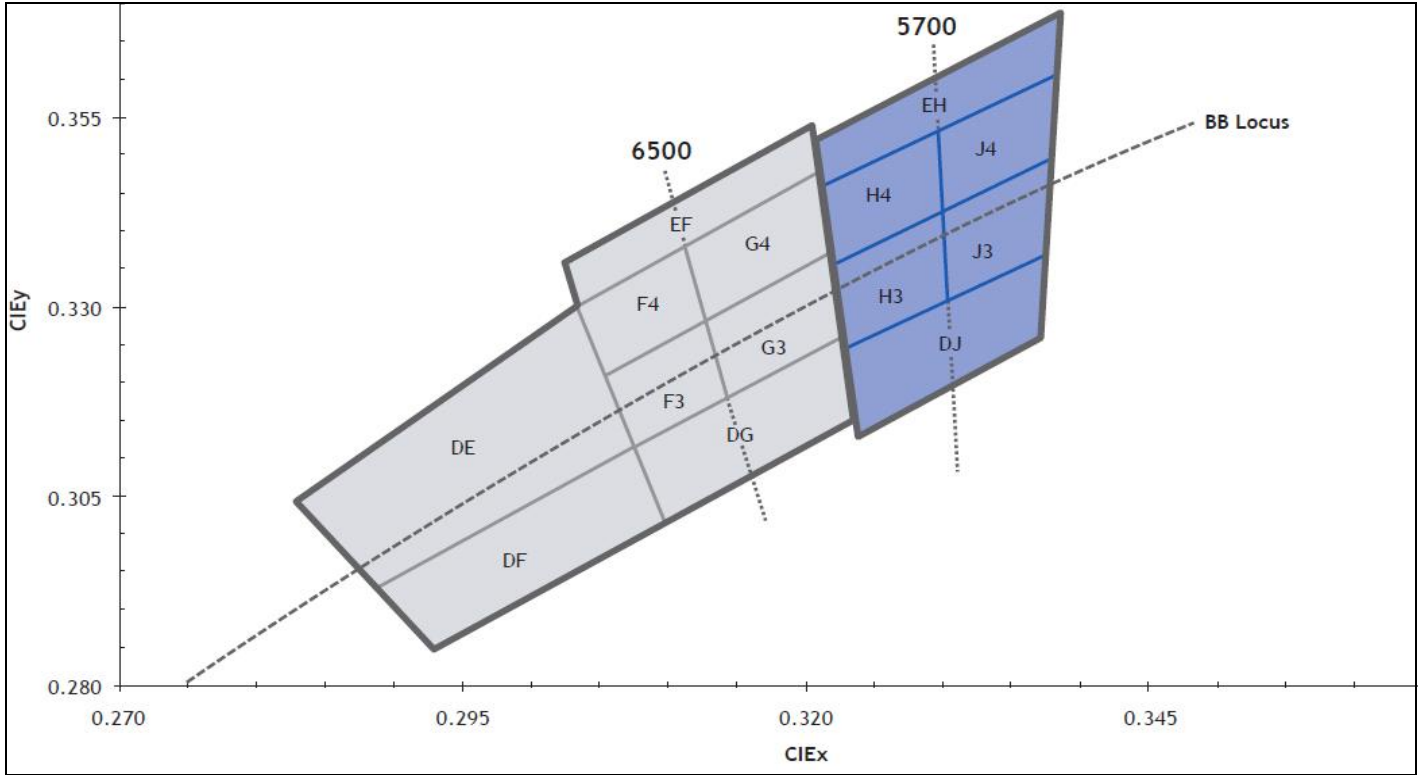
Chromaticity Bins

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

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

Luminus' Standard Chromaticity Bins: 1931 CIE Curve



PhlatLight Product Shipping and Labeling Information

All SBM-160 products are sold as bin kits, consisting of multiple bins. All products are packaged and labeled with their respective bin as outlined in the tables on page 4 and 5. Modules are packaged in trays of 10, with each package only containing one bin. The part number designation is as follows:

SBM 160 RGBW H41 XXXXX

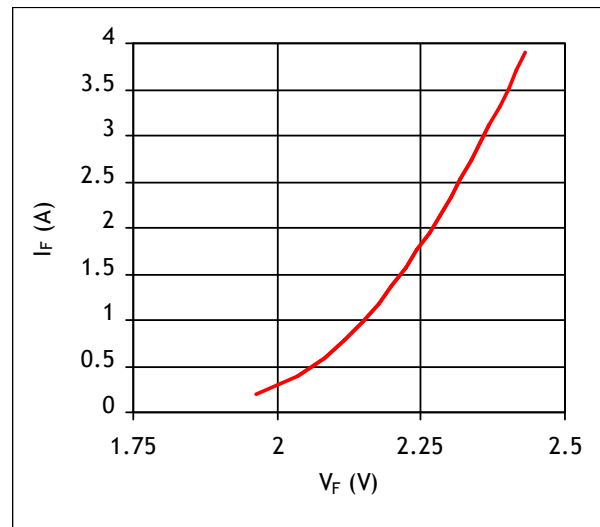
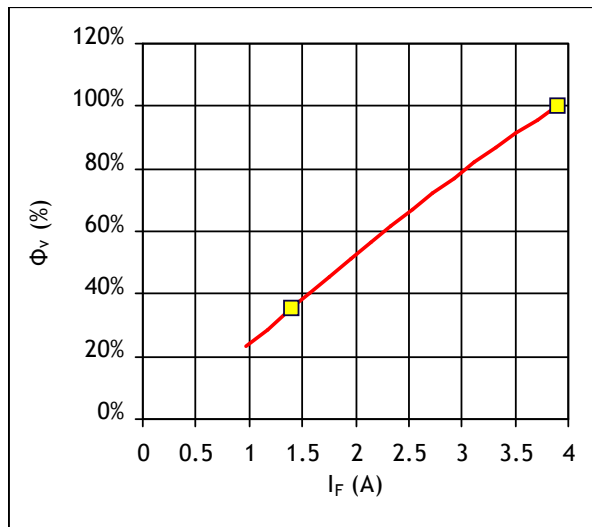
Product Family	Chip Area	Color	Package Configuration	Bin Kit
SBM: Windowed Surface Mount	160: 16mm ²	R: Red G: Green B: Blue W: White	H41: 10 x 11 mm board	XXXXX: Bin kit as denoted on pages 4 and 5

Note: Some flux and wavelength bins may have limited availability. Please consult the binning and labeling document for further information. For ordering information, please refer to page 17 or contact your local Luminus sales representative.

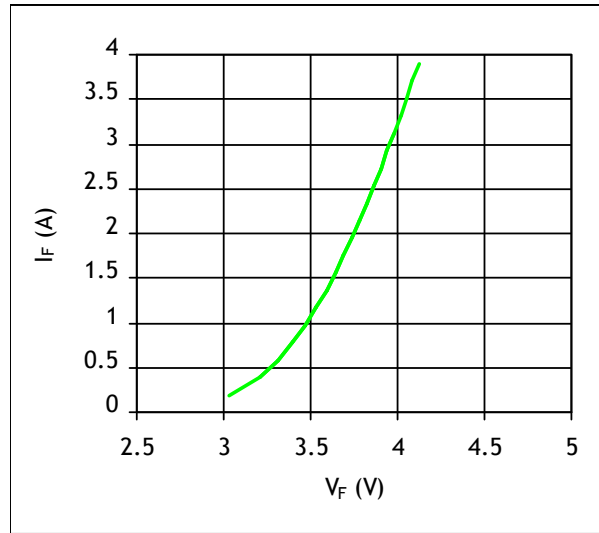
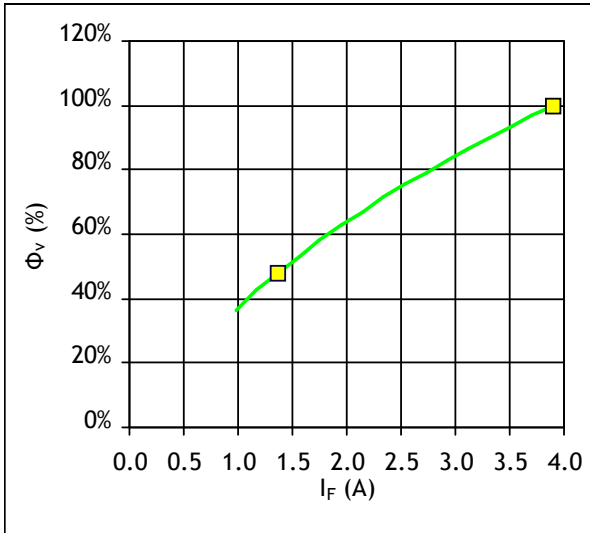
Optical and Electrical Characteristics³

		Red	Green	Blue	White	
Drive Condition ²		4.0 A	4.0 A	4.0 A	4.0 A	
Parameter	Symbol					Unit
Current Density	j	1.00	1.00	1.00	1.00	A/mm ²
Forward Voltage	V _F min	1.90	3.00	2.50	2.50	v
	V _F typ	2.50	4.60	3.80	3.80	v
	V _F max	2.60	5.10	4.80	5.50	v
Typical Luminous Flux ⁴	Φ _v typ	215	550	90	510	lm
Minimum Luminous Flux	Φ _v min	160	400	65	440	lm
Wavelength min-max	λ _d	619-624	520-530	450-460	N/A	nm
FWHM	Δλ _{1/2}	18	38	24	N/A	nm
Chromaticity Coordinates ^{5,6}	x	0.700	0.204	0.142	0.312	-
	y	0.300	0.716	0.043	0.328	-
Radiometric Efficiency	η _{rad}	21	6	15	13	%

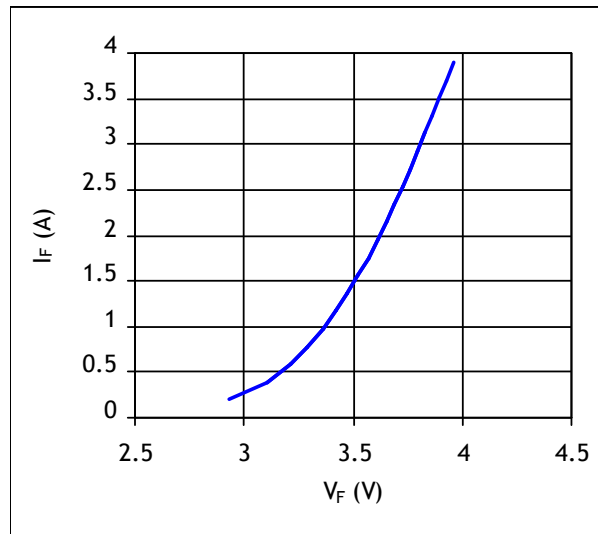
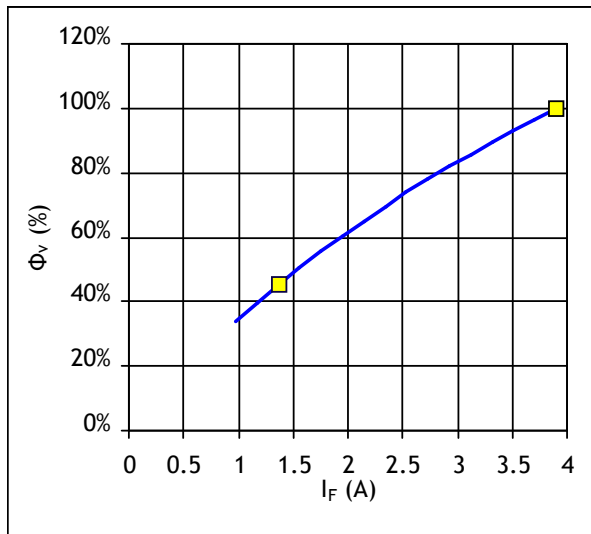
Characteristics curves for Red



Characteristics curves for Green

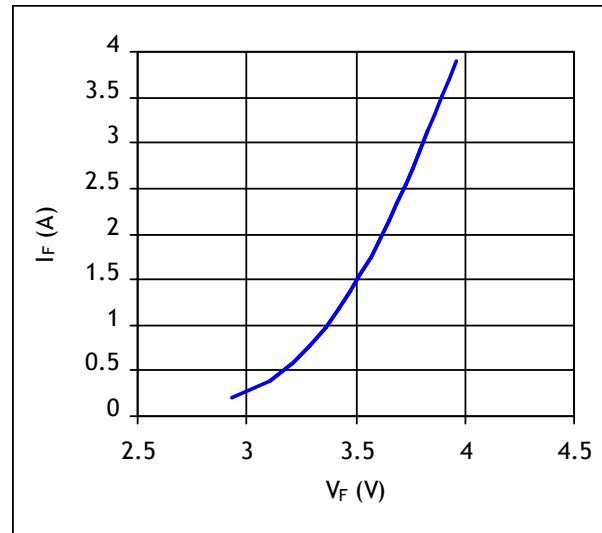
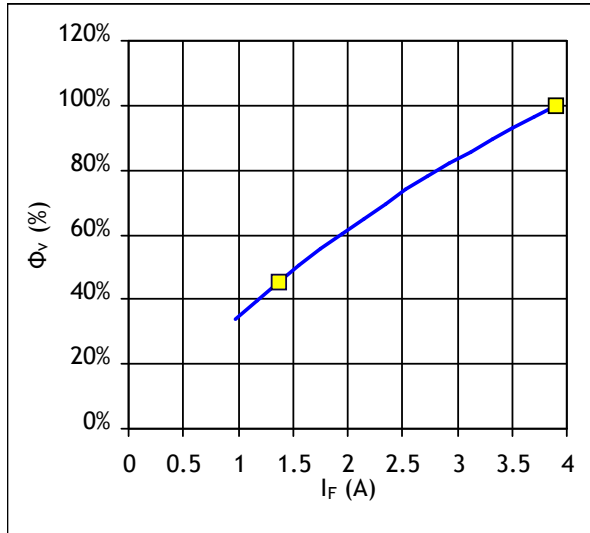


Characteristics curves for Blue



Note 13. All ratings are based on test conditions of T_j=25C, 20 millisecond pulse. See Thermal Resistance section for T_{hs} definition.

Characteristics curves for White



Yellow squares indicate reference drive conditions

Common Characteristics

Symbol	Red	Green	Blue	White	Unit
Emitting Area	4	4	4	4	mm ²
Emitting Area Dimensions	2.09 x 1.87	2.09 x 1.87	2.09 x 1.87	2.09 x 1.87	mm _x mm
Dynamic Resistance Ω _{dyn}	0.05	0.07	0.08	0.08	Ω
Thermal Coefficient of Photometric Flux	-1.14	-0.17	-0.008	-0.20	%/°C
Thermal Coefficient of Radiometric Flux	-0.69	-0.18	-0.13	-0.18	%/°C
Thermal Coefficient of Junction Voltage	-2.1	-3.9	-5.1	-4.5	mV/°C

Absolute Maximum Ratings

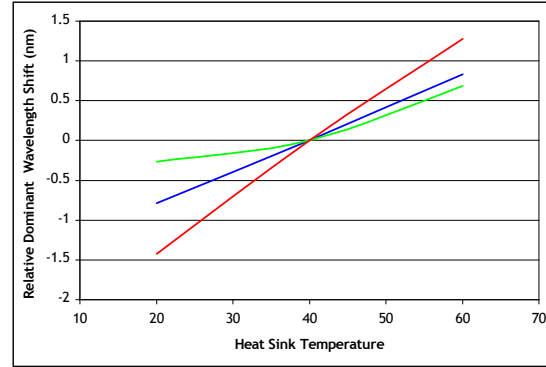
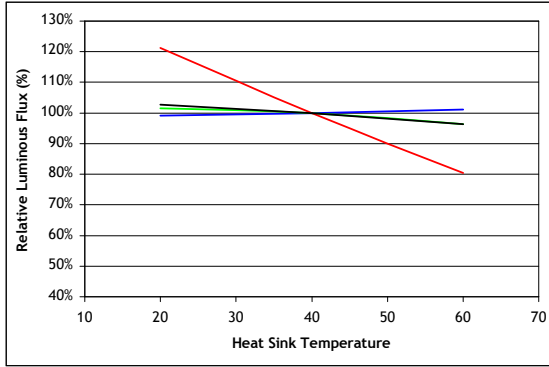
Symbol	Red	Green	Blue	White	Unit
Maximum Current ¹	4	4	4	4	A
Maximum Junction Temperature ² T _{jmax}	110	150	150	150	°C
Storage Temperature Range	-40/+100	-40/+100	-40/+100	-40/+100	°C

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

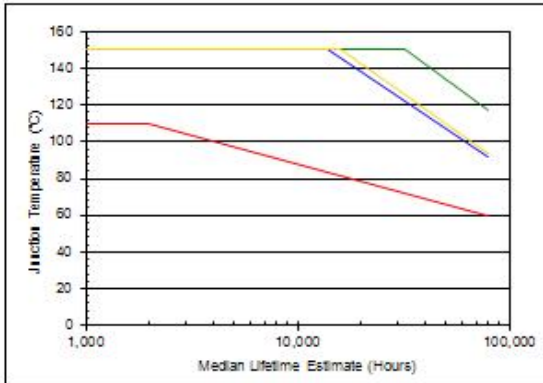
Note 2: Listed drive conditions are typical for common applications. PhlatLight SBM-160-RGBW devices can be driven at currents ranging from <1 A to 4 A and at duty cycles ranging from 1% to 100%. Drive current and duty cycle should be adjusted as necessary to maintain the junction temperature desired to meet application lifetime requirements.

- Note 3: Unless otherwise noted, values listed are typical. Devices are production tested and specified at 4 A for red, green, blue and white. Other values are for reference only.
- Note 4: Total flux from emitting area at listed dominant wavelength. Reported performance is included to show trends for a selected power level. For specific minimum and maximum values, use bin tables. For product roadmap and future performance of devices, contact Luminus.
- Note 5: In CIE 1931 chromaticity diagram coordinates, normalized to $X+Y+Z=1$.
- Note 6: For reference only.
- Note 7: CIE measurement uncertainty for white is estimated to be ± 0.01 .
- Note 8: Luminus PhlatLight LEDs are designed for operation to an absolute maximum current as specified above. Product lifetime data is specified at recommended forward drive currents. Sustained operation at or beyond 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 lifetime derating curves for further information. In pulsed operation, rise time from 10-90% of forward current should be larger than 0.5 microseconds.
- Note 9: Lifetime dependent on LED junction temperature. Input power and thermal system must be properly managed to ensure lifetime. See charts on pg 12 for further information.
- Note 10: Special design considerations must be observed for operation under 1 A. Please contact Luminus for further information.
- Note 11: Caution must be taken not to stare at the light emitted from these LEDs. Under special circumstances, the high intensity could damage the eye

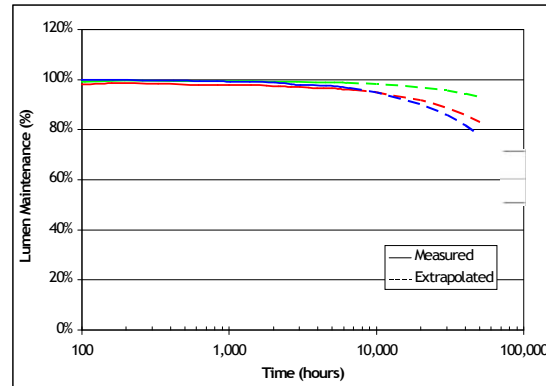
Light Output and Spectral Characteristics Over Heat Sink Temperature



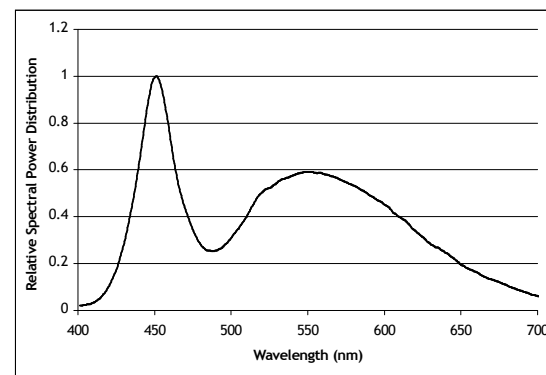
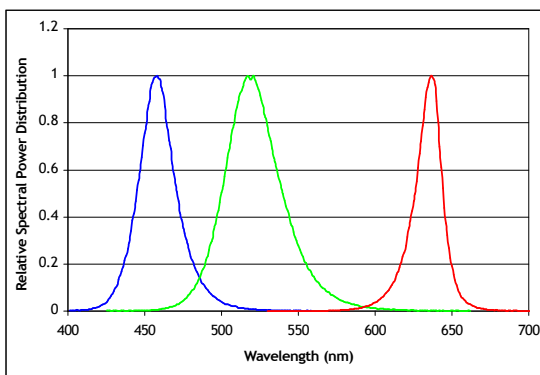
Median Lifetime Estimate vs. Tj¹³



Lumen Maintenance¹⁴



Typical Spectrum¹⁵

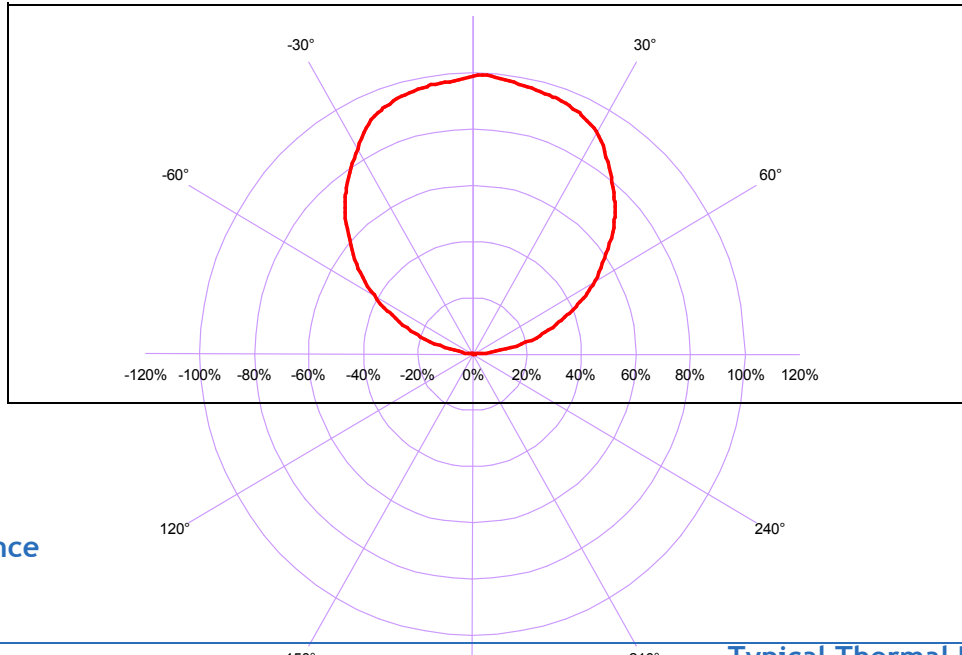


Note 13. Median lifetime estimate as a function of junction temperature at 1.0A/mm² in continuous operation. Lifetime defined as time to 70% of initial intensity. Based on preliminary lifetime test data from single-chip modules. Data can be used to model failure rate over typical product lifetime.

Note 14. Lumen maintenance vs. time at 1.0A/mm² in continuous operation, Red junction temperature of 70°C, Green junction temperatures of 120°C, Blue and White junction temperatures of 100°C.

Note 15. Typical spectrum at current density of 1.0 A/mm² in continuous operation

Typical Polar Radiation Pattern



Thermal Resistance

A cross-sectional diagram of the device showing thermal nodes and components. The nodes are labeled as T_j (Die Junction), T_c (Ceramic Substrate), T_b (Al coreboard), and T_{hs} (Heat sink). The components are labeled as Window, Die Junction, Window Frame, Ceramic Substrate, Al coreboard, Thermistor, and Heat sink. The T_{ref} node is also shown. The T_{hs} definition is 3 mm from core-board.

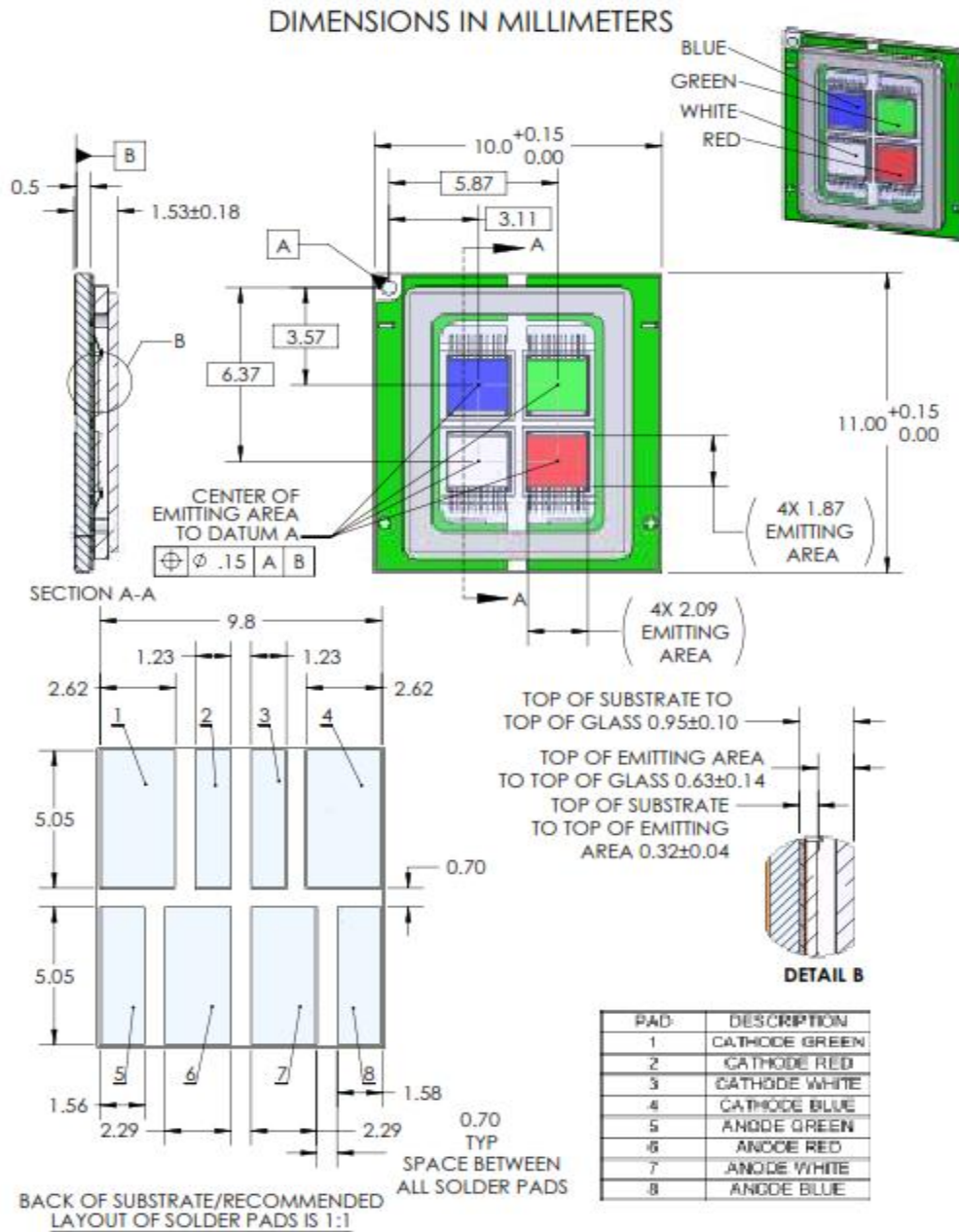
Chip	R/G/B/W
$R_{\theta C-ref}^1$	0.62

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

Thermistor Information

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

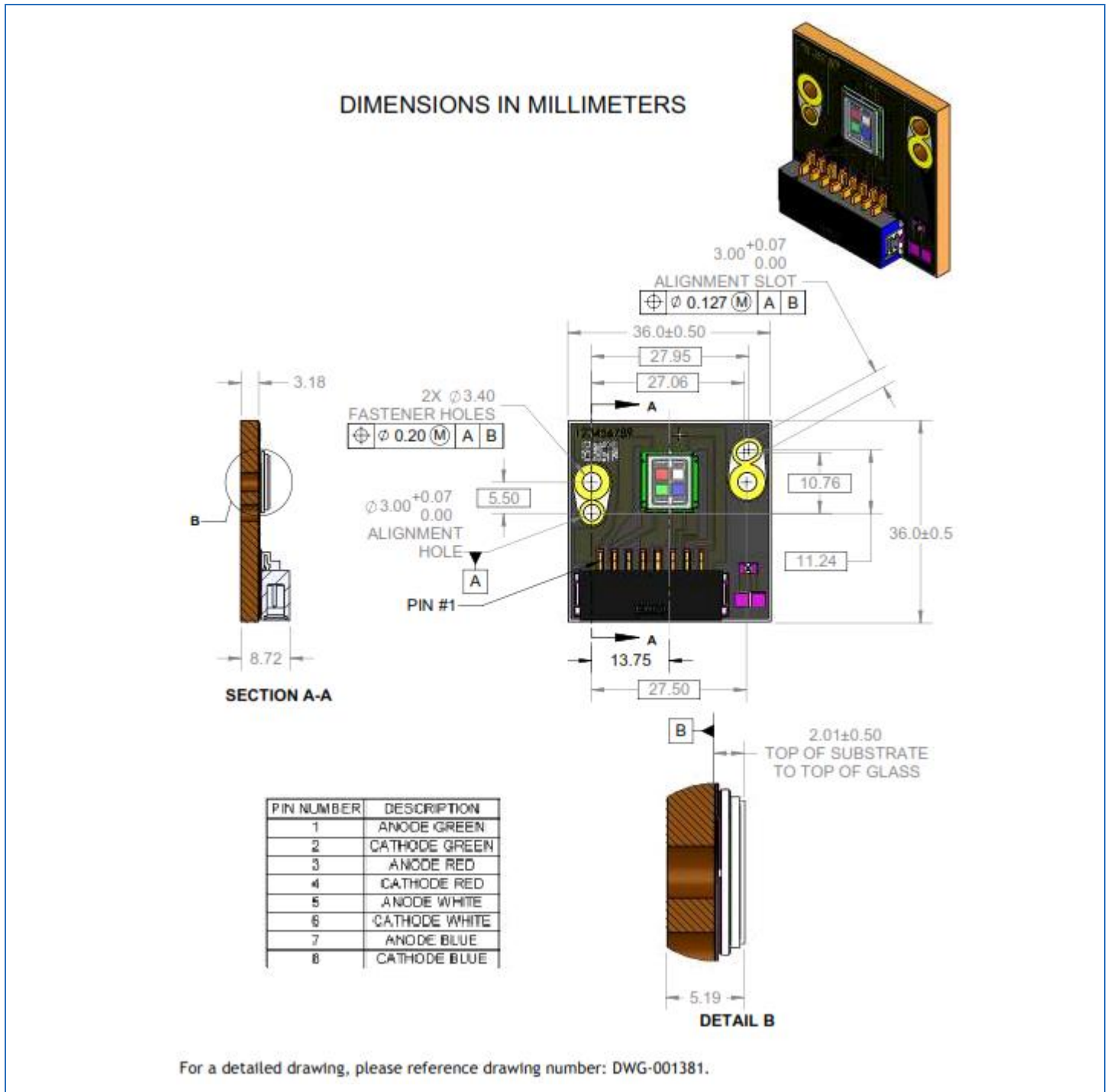
Mechanical Dimensions - SBM-160 Emitter



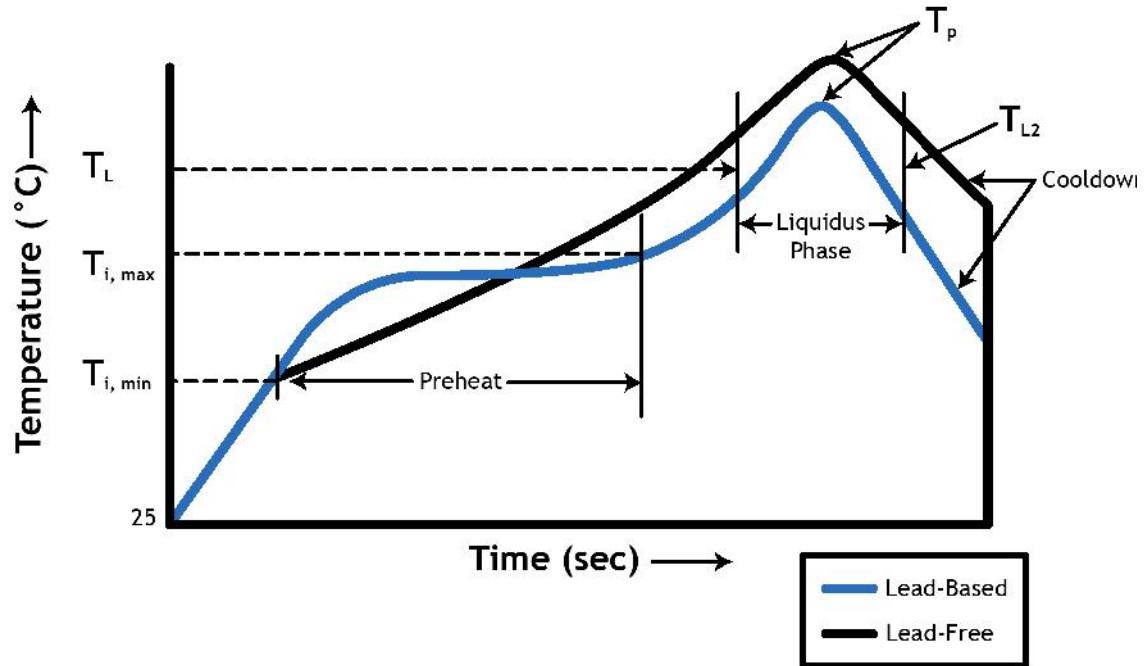
For a detailed drawing, please reference drawing number: DWG-001374.

Mechanical Dimensions - SBM-160 Development Board

PhlatLight SBM-160 devices are available premounted on a copper-clad MCPCB for prototyping purposes. Please see page 17 for ordering information.



Solder Profile



Solder Profile Stage	Lead-Free Solder	Lead-Based Solder
Rate of Rise	2°C/sec max	2°C/sec max
Preheat Min Temp (T _{i,min})	100°C	120°C
Preheat Max Temp (T _{i,max})	175°C	130°C
Preheat Time (T _{p,min} to T _{i,max})	90 seconds	120 seconds
Liquidus Min Temp: (T _L)	185°C	160°C
Liquidus to Liquidus Time (T _L to T _{L2})	30-60 seconds	30 seconds
Liquidus Peak Temp (T _p)	240°C max	220°C max
Cooldown	≤ 4°C/sec	≤ 6°C/sec
Profile Length (Ambient to Peak)	4 min	3.5 - 4 min

1. Temperatures are taken and monitored at the component copper layer
2. Optimum profile may differ due to oven type, circuit board or assembly layout
3. Recommended lead free, no-clean solder: AIM NC254-SAC305
4. Refer to soldering and handling application note for further information.

Ordering Information

Ordering Part Number ^{1,2}	Color	Description
SBM-160-RGBW-H41-RE102	RGBW	PhlatLight SBM-160-RGBW surface mount device consisting of a red 4 mm ² LED, a green 4 mm ² LED, a blue 4 mm ² LED, a white 4 mm ² LED
SBR-160-RGBW-R41-RE102	RGBW	PhlatLight SBR-160-RGBW evaluation module consisting of a SBM-160-RGBW surface mount device mounted on a copper evaluation board

Note 1: SBM-160-RGBW-H41-RE102 denotes a bin kit comprising of all flux and wavelength bins as listed on page 3 and all flux and chromaticity bins listed on page 4 and 5.

Note 2: For info on ordering bin kits, contact your local Luminus sales representative.

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