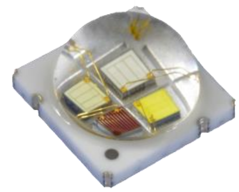
RGBW pin aligned LED Emitter

LZ4-00MD09



Key Features

- High Luminous Efficacy 4-die RGBW LED
- Individually addressable Red, Green, Blue and Daylight White die
- Anodes and Cathodes are aligned for easy connection of multiple emitters
- Electrically neutral thermal path
- Ultra-small foot print – 7.0mm x 7.0mm
- Surface mount ceramic package with integrated glass lens
- Low Thermal Resistance (2.8°C/W)
- Very high Luminous Flux density
- JEDEC Level 1 for Moisture Sensitivity Level
- Autoclave compliant (JEDEC JESD22-A102-C)
- Lead (Pb) free and RoHS compliant
- Reflow solderable (up to 6 cycles)

Typical Applications

- Architectural Lighting
- Retail Spot and Display Lighting
- Stage and Studio Lighting
- Hospitality Lighting
- Museum Lighting
- Video Walls and Full Color Displays

Description

The LZ4-00MD09 RGBW LED emitter contains one red, green, blue and daylight white LED die which provides 10W power in an extremely small package. With a 7.0mm x 7.0mm ultra-small footprint, this package allows close proximity to the LED die for optical systems designs that require imaging optics. LED Engin's RGBW LED offers ultimate design flexibility with individually addressable die. The LZ4-00MD09 is capable of producing a continuous spectrum of white light plus millions of colors. The patented design has unparalleled thermal and optical performance. The high quality materials used in the package are chosen to optimize light output and minimize stresses which results in monumental reliability and lumen maintenance. The robust product design thrives in outdoor applications with high ambient temperatures and high humidity.

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Part number options

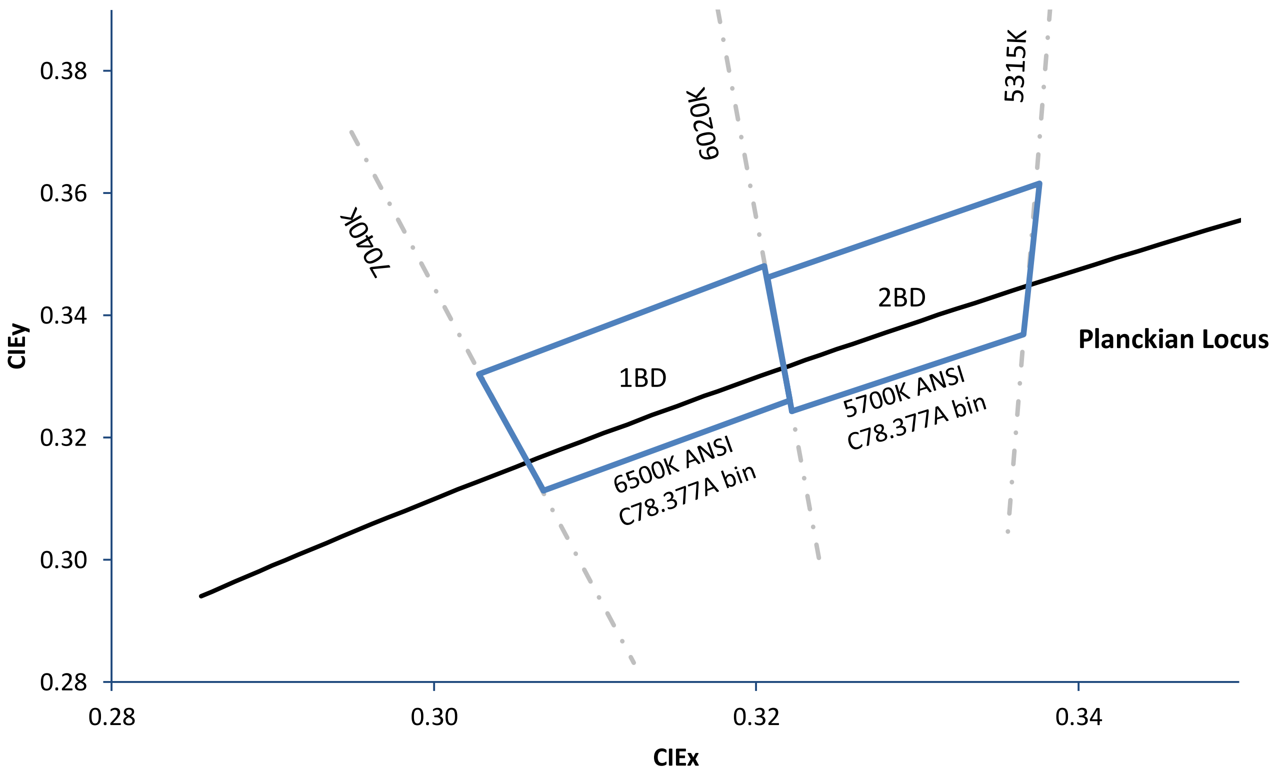
Base part number

Part number	Description
LZ4-00MD09-xxxx	LZ4 RGBW emitter pin aligned
LZ4-60MD09-xxxx	LZ4 RGBW emitter pin aligned on 4 channel Star MCPCB

Bin kit option codes

CW, Cool White (5500K – 6500K)			
Kit number suffix	**Min flux Bin**	**Color Bin Ranges**	**Description**
0000	17R	R2 – R2	Red, full distribution flux; full distribution wavelength
	12G	G2 – G3	Green, full distribution flux; full distribution wavelength
	17B	B01 – B02	Blue, full distribution flux; full distribution wavelength
	PQ	1BD, 2BD	White full distribution flux and CCT

Daylight White Chromaticity Groups



Standard Chromaticity Groups plotted on excerpt from the CIE 1931 (2°) x-y Chromaticity Diagram.
Coordinates are listed below in Table 5.

Cool White Bin Coordinates

Bin Code	CIEx	CIEy	Bin Code	CIEx	CIEy
1BD	0.3068	0.3113	2BD	0.3222	0.3243
	0.3028	0.3304		0.3207	0.3462
	0.3205	0.3481		0.3376	0.3616
	0.3221	0.3261		0.3366	0.3369
	0.3068	0.3113		0.3222	0.3243

Luminous Flux Bins

Table 1:

Bin Code	Minimum Luminous Flux (Φ_V) @ I_F = 700mA [1,2] (lm)				Maximum Luminous Flux (Φ_V) @ I_F = 700mA [1,2] (lm)			
	1 Red	1 Green	1 Blue	1 White	1 Red	1 Green	1 Blue	1 White
17R	105				160			
12G		125				195		
17B			19				30	
18B			30				47	
PQ				182				285

Notes for Table 1:
1. Luminous flux performance guaranteed within published operating conditions. LED Engin maintains a tolerance of ±10% on flux measurements.
2. Future products will have even higher levels of radiant flux performance. Contact LED Engin Sales for updated information.

Dominant Wavelength Bins

Table 2:

Bin Code	Minimum Dominant Wavelength (λ_D) @ I_F = 700mA [1] (nm)			Maximum Dominant Wavelength (λ_D) @ I_F = 700mA [1] (nm)		
	1 Red	1 Green	1 Blue	1 Red	1 Green	1 Blue
R2	618			630		
G2		520			525	
G3		525			530	
B01			452			457
B02			457			462

Notes for Table 2:
1. LED Engin maintains a tolerance of ± 1.0nm on dominant wavelength measurements.

Forward Voltage Bin

Table 3:

Bin Code	Minimum Forward Voltage (V_F) @ I_F = 700mA [1] (V)				Maximum Forward Voltage (V_F) @ I_F = 700mA [1] (V)			
	1 Red	1 Green	1 Blue	1 White	1 Red	1 Green	1 Blue	1 White
0	2.10	3.20	2.80	2.80	2.90	4.20	3.80	3.80

Notes for Table 3:
1. LED Engin maintains a tolerance of ± 0.04V on forward voltage measurements.

Absolute Maximum Ratings

Table 4:

Parameter	Symbol	Value	Unit
DC Forward Current	I_F	1000	mA
Peak Pulsed Forward Current [2]	I_{FP}	1500	mA
Reverse Voltage	V_R	See Note 3	V
Storage Temperature	T_{std}	-40 ~ +150	°C
Junction Temperature	T_J	125	°C
Soldering Temperature [4]	T_{sol}	260	°C
Allowable Reflow Cycles		6	
Autoclave Conditions [5]		121°C at 2 ATM, 100% RH for 168 hours	
ESD Sensitivity [6]		> 8,000 V HBM Class 3B JESD22-A114-D	

Notes for Table 4:
1. Maximum DC forward current is determined by the overall thermal resistance and ambient temperature. Follow the curves in Figure 12 for current derating. Max current for continues operation is 1.0A
2: Pulse forward current conditions: Pulse Width ≤ 10msec and Duty Cycle ≤ 10%.
3. LEDs are not designed to be reversing biased.
4. Solder conditions per JEDEC 020D. See Reflow Soldering Profile Figure 4.
5. Autoclave Conditions per JEDEC JESD22-A102-C.
6. LED Engin recommends taking reasonable precautions towards possible ESD damages and handling the emitter in an electrostatic protected area (EPA). An EPA may be adequately protected by ESD controls as outlined in ANSI/ESD S6.1.

Optical Characteristics @T_C = 25°C

Table 5:

Parameter	Symbol	Typical				Unit
		Red	Green	Blue [1]	White	
Luminous Flux (@ I_F = 700mA)	Φ_V	130	165	39	240	lm
Luminous Flux (@ I_F = 1000mA)	Φ_V	180	215	50	315	lm
Dominant Wavelength		623	523	457		
Correlated Color Temperature	CCT				6500	K
Color Rendering Index (CRI)	R_a				75	
Viewing Angle [2]	$2\Theta_{½}$	95				
Total Included Angle [3]	$\Theta_{0.9}$	115				Degrees

Notes for Table 5:
1. When operating the Blue LED, observe IEC 60825-1 class 2 rating. Do not stare into the beam.
2. Viewing Angle is the off axis angle from emitter centerline where the luminous intensity is ½ of the peak value.
3. Total Included Angle is the total angle that includes 90% of the total luminous flux.

Electrical Characteristics @T_C = 25°C

Table 6:

Parameter	Symbol	Typical				Unit
		Red	Green	Blue	White	
Forward Voltage (@ I_F = 700mA)	V_F	2.5	3.6	3.2	3.2	V
Temperature Coefficient of Forward Voltage	$\Delta V_F/\Delta T_J$	-1.9	-2.9	-2.0	-2.0	mV/°C
Thermal Resistance (Junction to Case)	$R\Theta_{J-C}$	2.8				°C/W

IPC/JEDEC Moisture Sensitivity Level

Table 7 - IPC/JEDEC J-STD-20D.1 MSL Classification:

			Soak Requirements			
	Floor Life		Standard		Accelerated	
Level	Time	Conditions	Time (hrs)	Conditions	Time (hrs)	Conditions
1	Unlimited	≤ 30°C/ 85% RH	168 +5/-0	85°C/ 85% RH	n/a	n/a

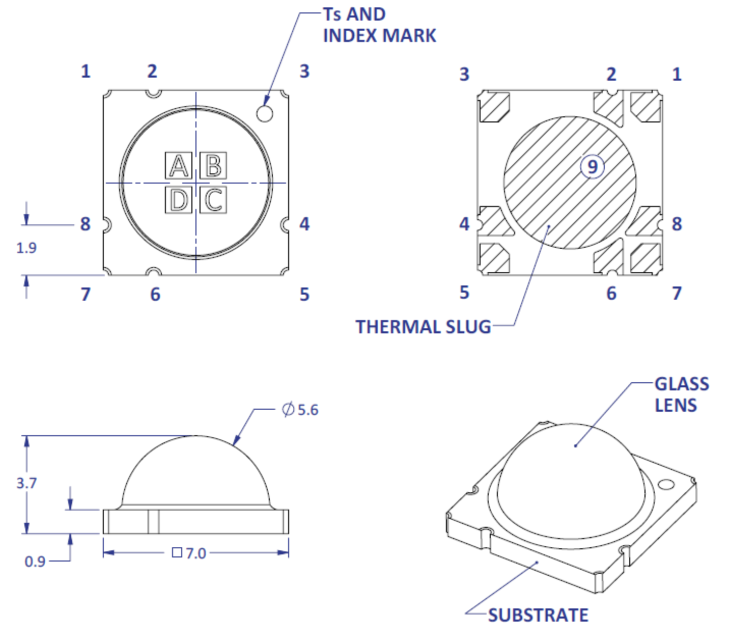
Notes for Table 7:
1. The standard soak time includes a default value of 24 hours for semiconductor manufacturer's exposure time (MET) between bake and bag and includes the maximum time allowed out of the bag at the distributor's facility.

Average Lumen Maintenance Projections

Lumen maintenance generally describes the ability of a lamp to retain its output over time. The useful lifetime for solid state lighting devices (Power LEDs) is also defined as Lumen Maintenance, with the percentage of the original light output remaining at a defined time period.

Based on long-term WHTOL testing, LED Engin projects that the LZ Series will deliver, on average, 70% Lumen Maintenance at 65,000 hours of operation at a forward current of 700mA. This projection is based on constant current operation with junction temperature maintained at or below 125°C for LZ4 product.

Mechanical Dimensions (mm)



Pin Out			
Pad	Die	Color	Function
1	A	Green	Anode
2	D	Blue	Anode
3	B	Red	Anode
4	C	White	Anode
5	C	White	Cathode
6	B	Red	Cathode
7	D	Blue	Cathode
8	A	Green	Cathode
9 [2]	n/a	n/a	Thermal

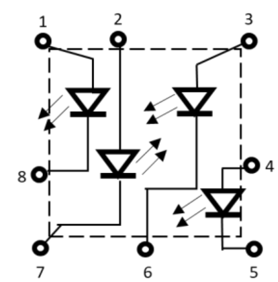


Figure 1: Package Outline Drawing.

Notes for Figure 1:
1. Unless otherwise noted, the tolerance = ± 0.20 mm.
2. Thermal contact, Pad 9, is electrically neutral.

Recommended Solder Pad Layout (mm)

Non-pedestal MCPCB Design

Pedestal MCPCB Design

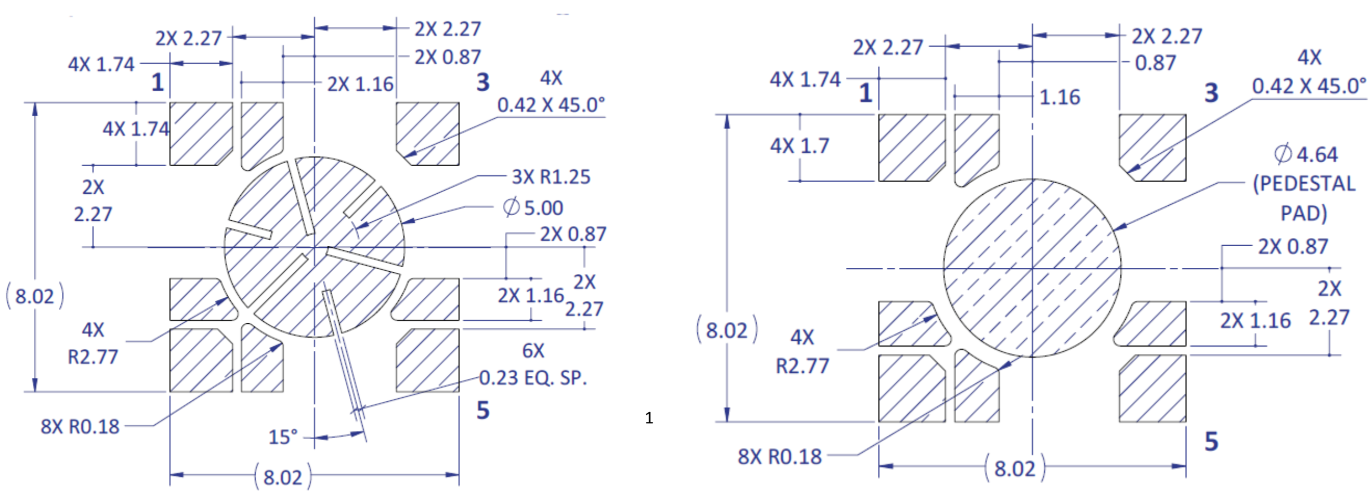


Figure 2a: Recommended solder pad layout for anode, cathode, and thermal pad for non-pedestal and pedestal design

Note for Figure 2a:
1. Unless otherwise noted, the tolerance = ± 0.20 mm.
2. Pedestal MCPCB allows the emitter thermal slug to be soldered directly to the metal core of the MCPCB. Such MCPCB eliminate the high thermal resistance dielectric layer that standard MCPCB technologies use in between the emitter thermal slug and the metal core of the MCPCB, thus lowering the overall system thermal resistance.
3. LED Engin recommends x-ray sample monitoring for solder voids underneath the emitter thermal slug. The total area covered by solder voids should be less than 20% of the total emitter thermal slug area. Excessive solder voids will increase the emitter to MCPCB thermal resistance and may lead to higher failure rates due to thermal over stress.

Recommended Solder Mask Layout (mm)

Non-pedestal MCPCB Design   Pedestal MCPCB Design

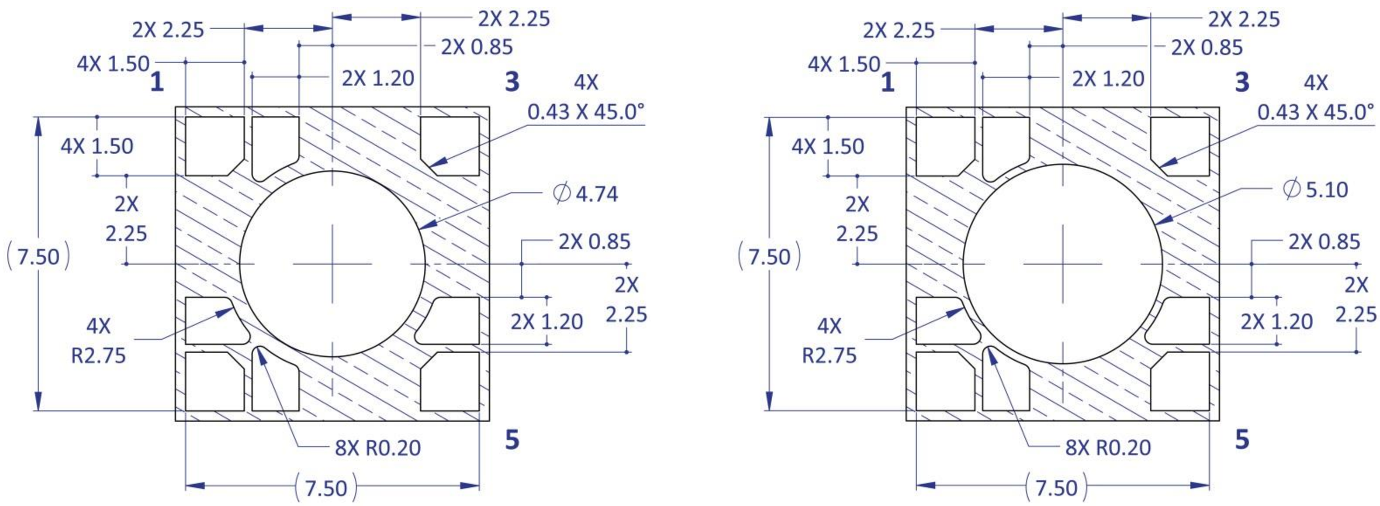


Figure 2b: Recommended solder mask opening for anode, cathode, and thermal pad for non-pedestal and pedestal design

Note for Figure 2b:
1. Unless otherwise noted, the tolerance = ± 0.20 mm.

Recommended 8 mil Stencil Apertures Layout (mm)

Non-pedestal MCPCB Design   Pedestal MCPCB Design

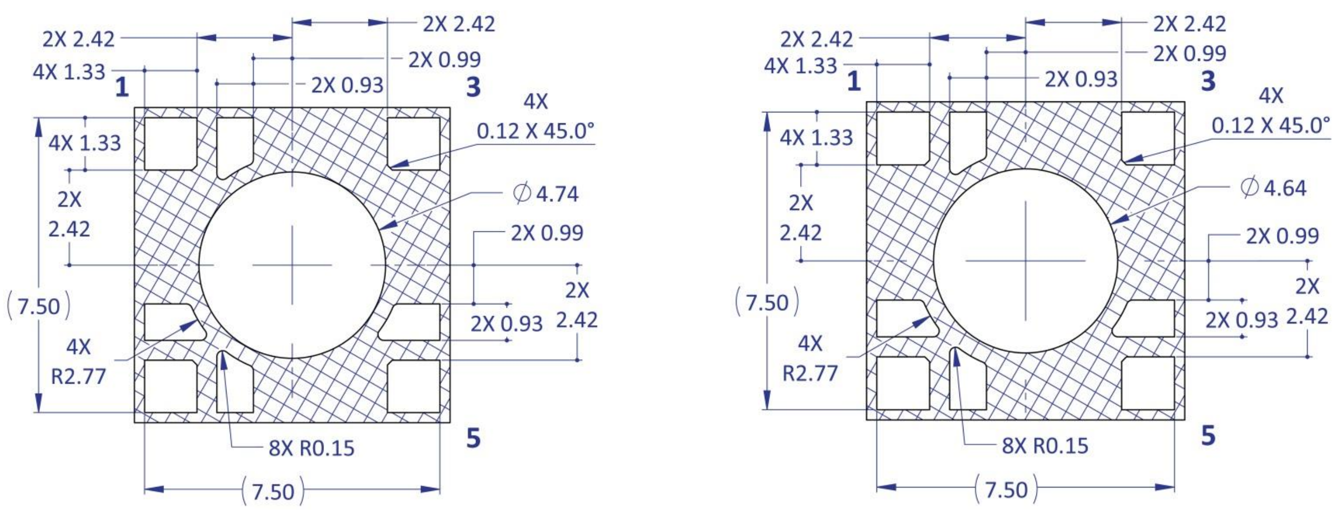


Figure 2c: Recommended 8mil stencil apertures for anode, cathode, and thermal pad for non-pedestal and pedestal design

Note for Figure 2c:
1. Unless otherwise noted, the tolerance = ± 0.20 mm.

Reflow Soldering Profile

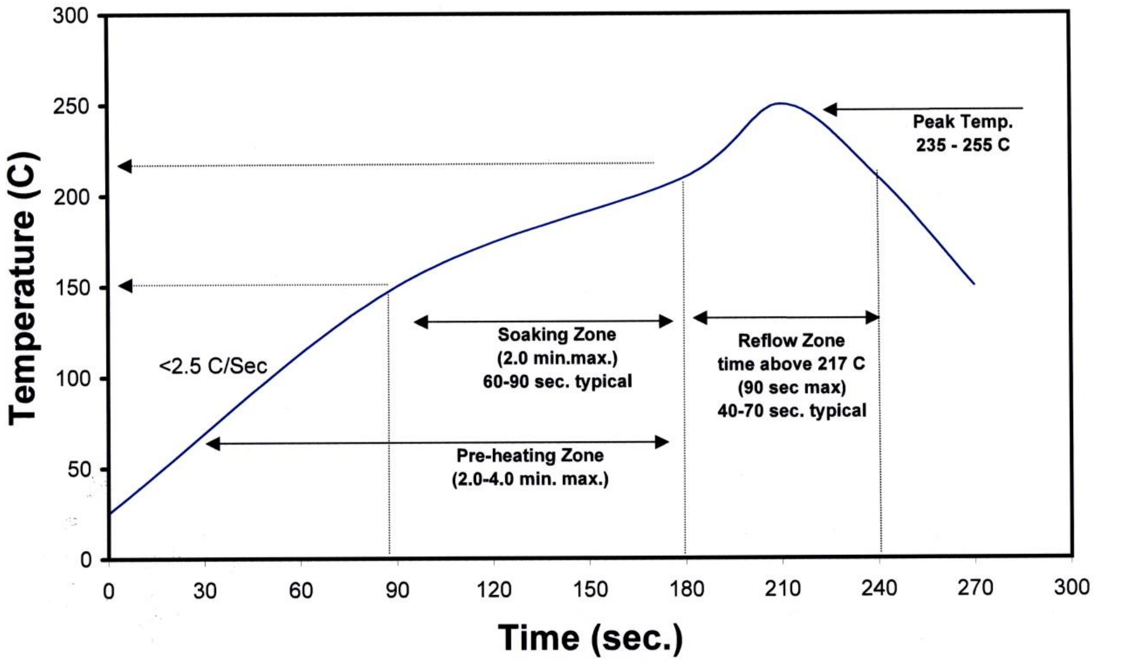


Figure 3: Reflow soldering profile for lead free soldering.

Typical Radiation Pattern

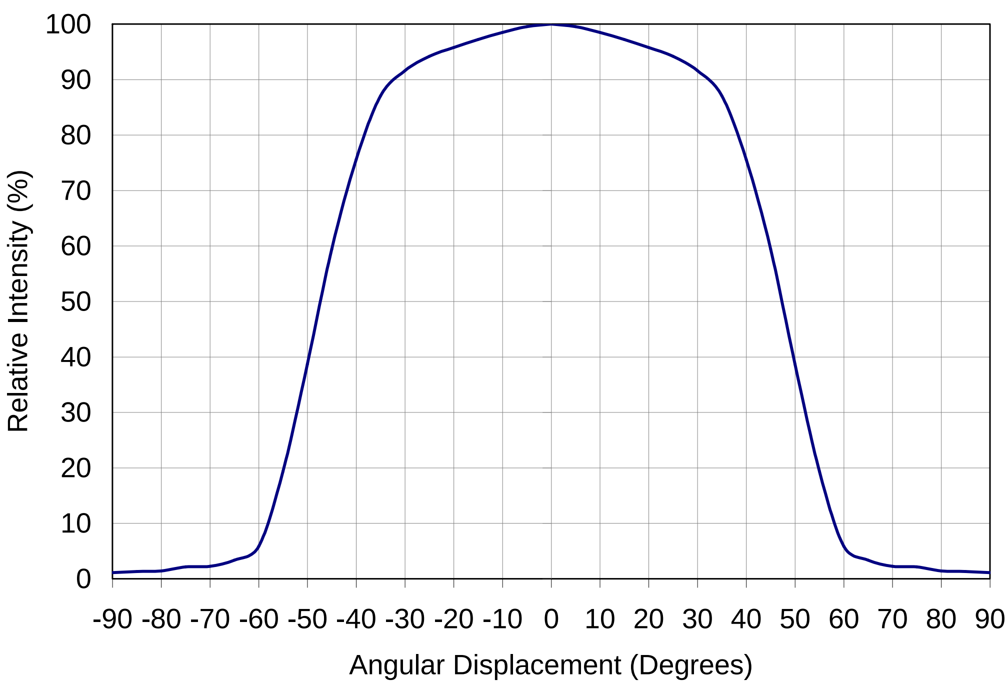


Figure 4: Typical representative spatial radiation pattern.

Typical Relative Spectral Power Distribution

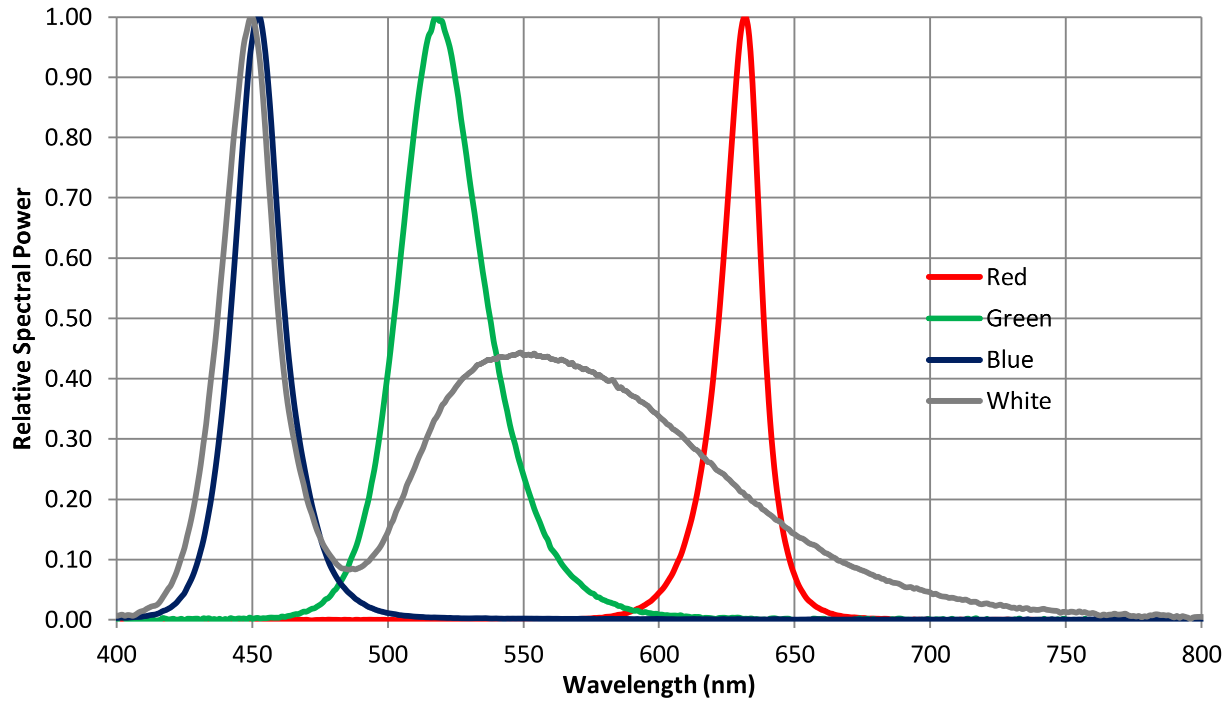


Figure 5: Typical relative spectral power vs. wavelength @ T_C = 25°C.

Typical Forward Current Characteristics

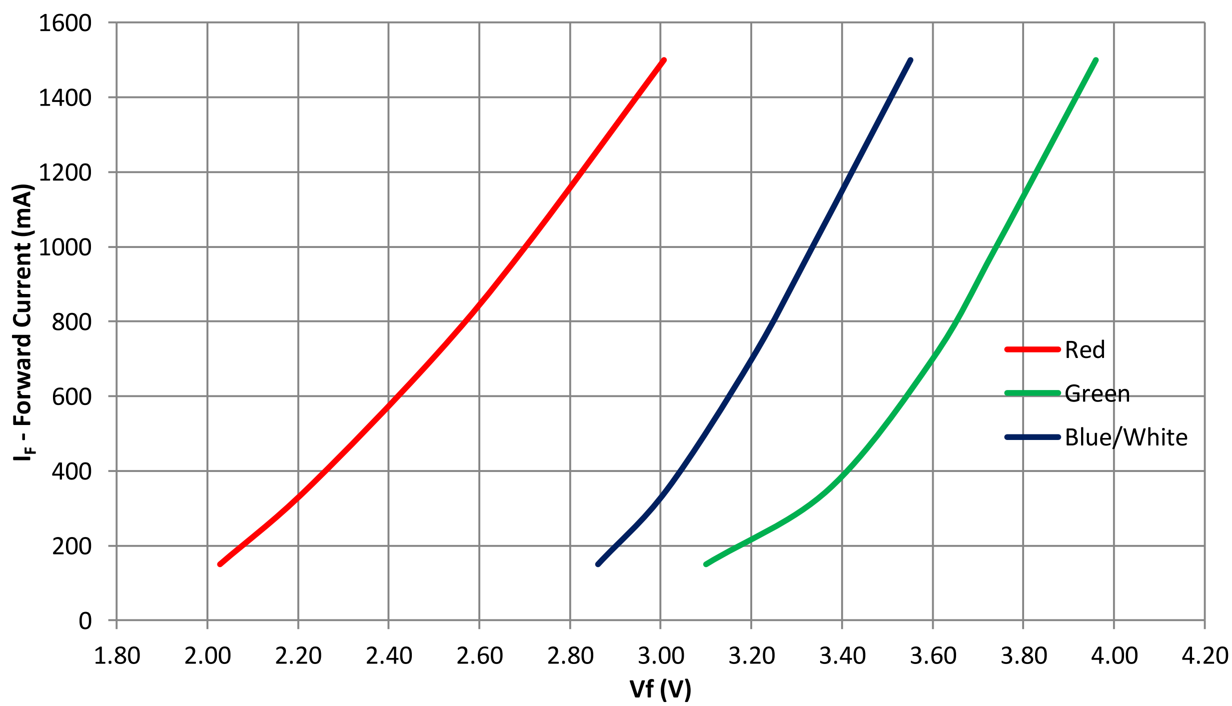


Figure 6: Typical forward current vs. forward voltage @ T_C = 25°C

Typical Relative Light Output over Current

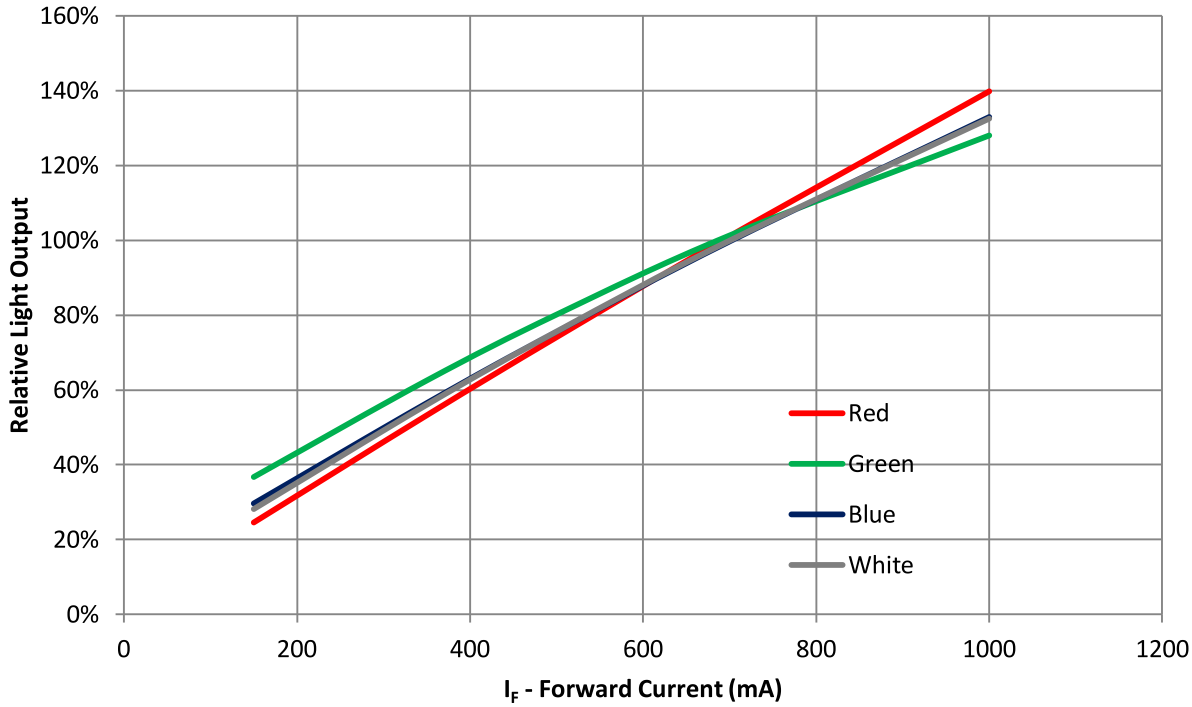


Figure 7: Typical relative light output vs. forward current @ T_C = 25°C

Typical Relative Light Output over Temperature

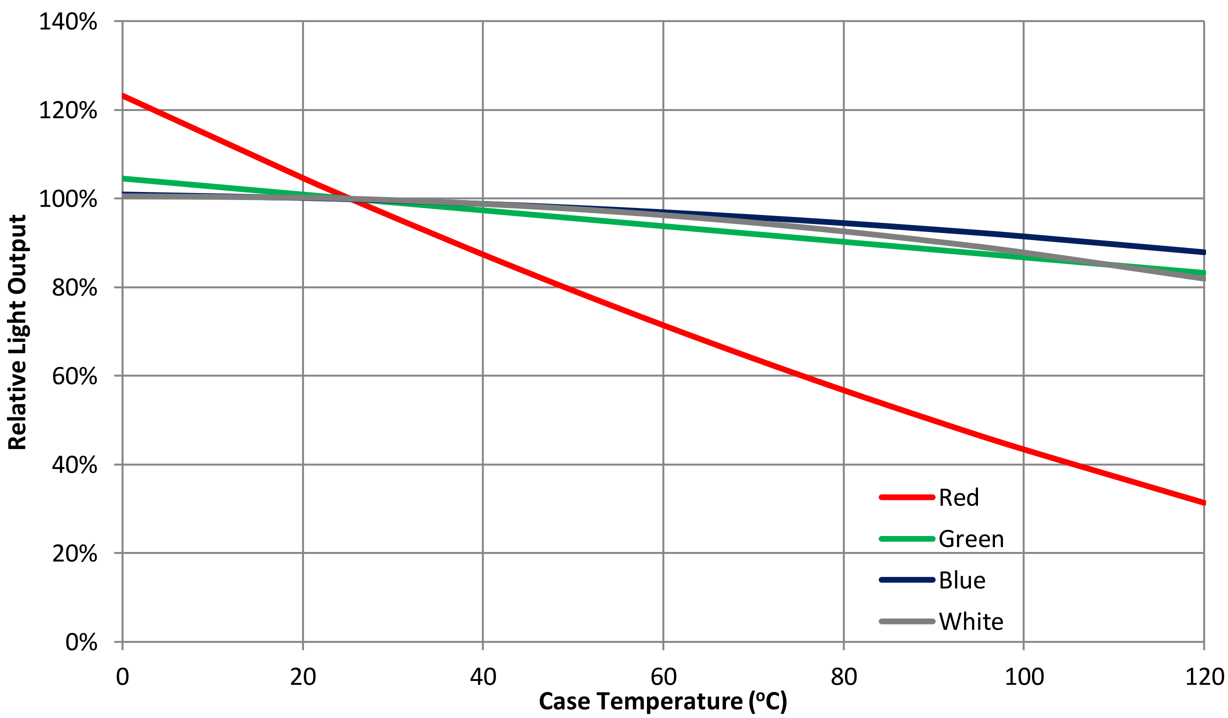


Figure 8: Typical relative light output vs. case temperature.

Typical Dominant Wavelength/Chromaticity Coordinate Shift over Current

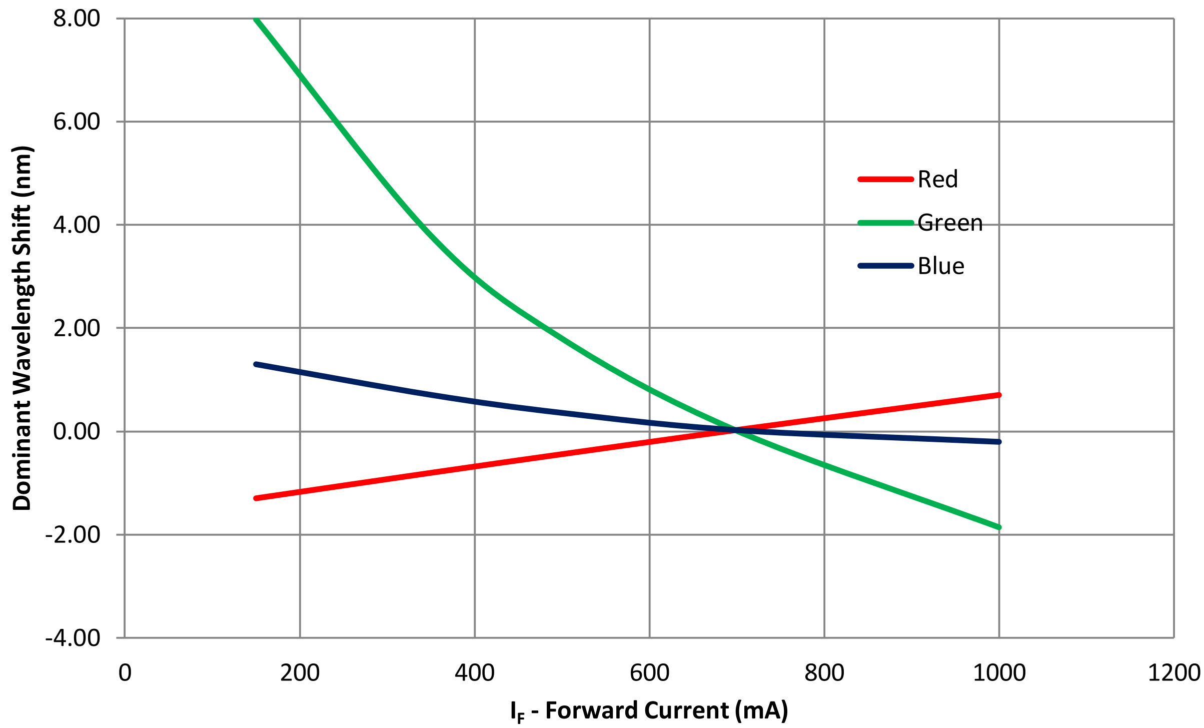


Figure 9a: Typical dominant wavelength shift vs. forward current @ T_C = 25°C.

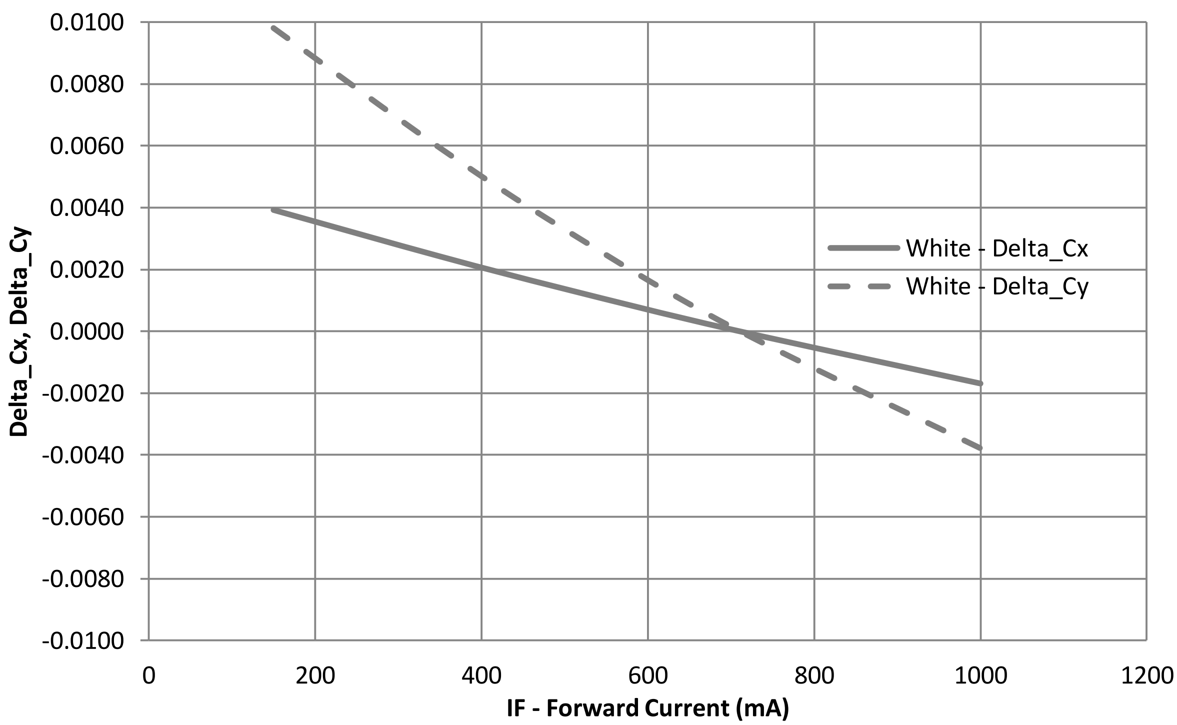


Figure 9b: Typical chromaticity coordinate shift vs. forward current @ T_C = 25°C.

Typical Dominant Wavelength/Chromaticity Coordinate Shift over Temperature

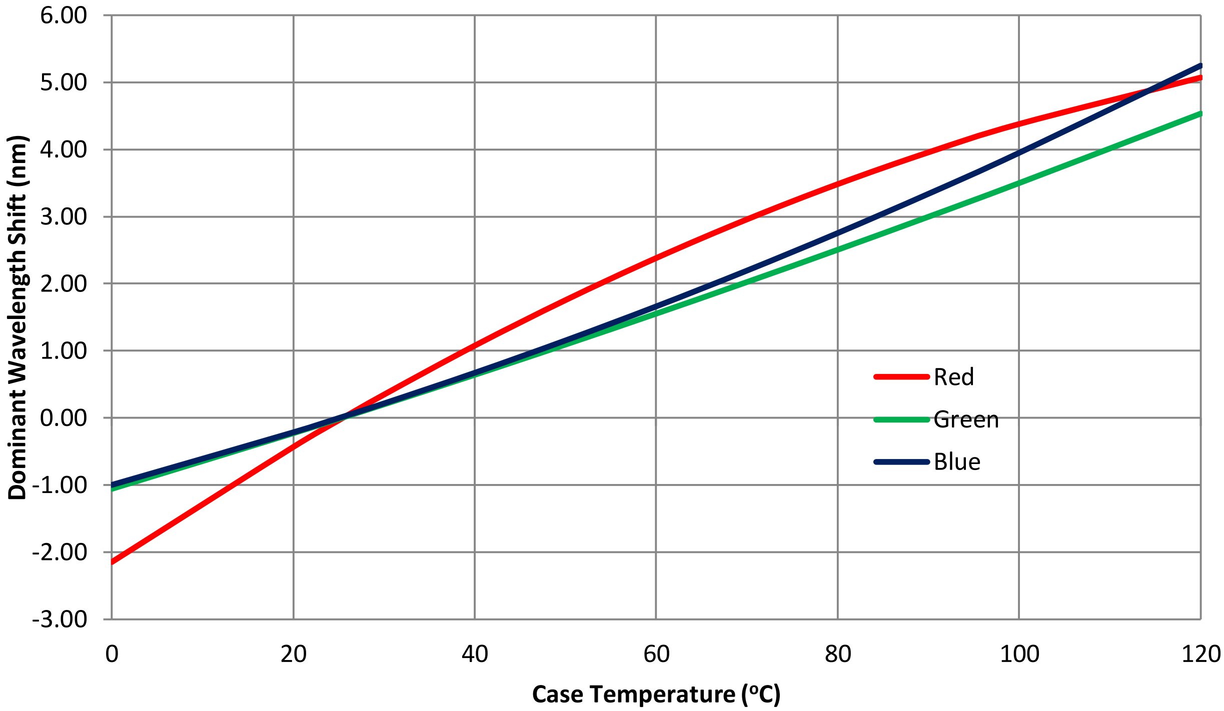


Figure 10a: Typical dominant wavelength shift vs. case temperature

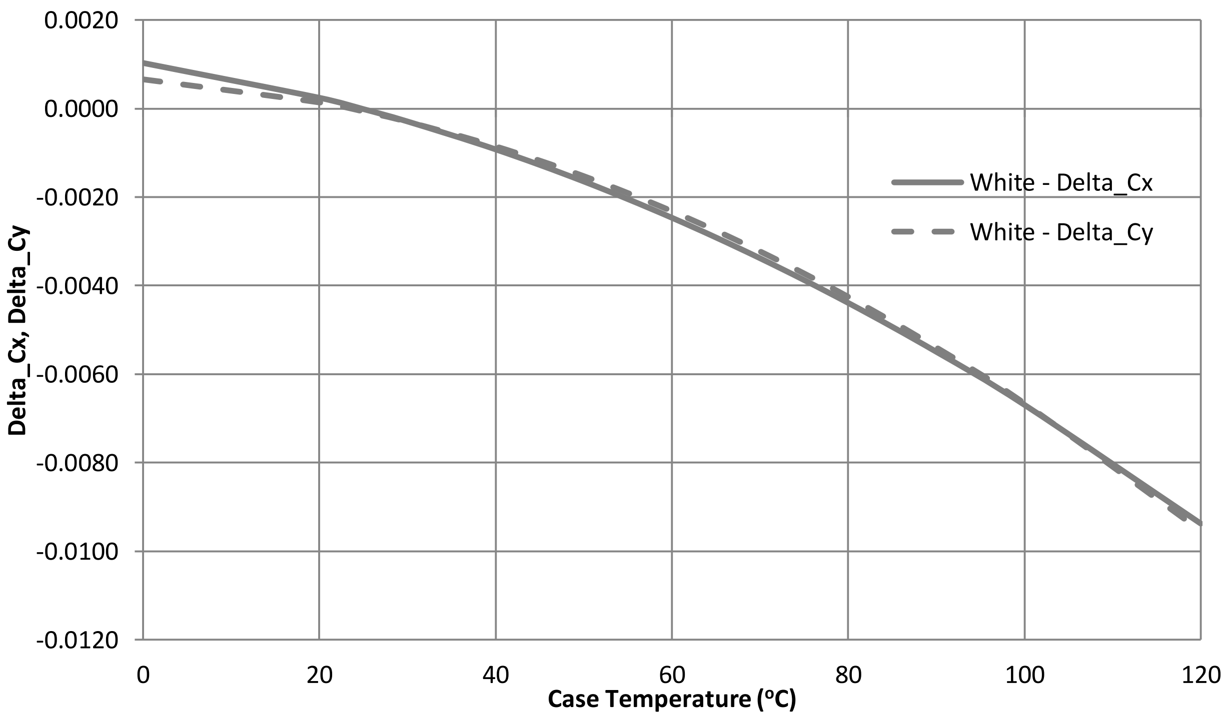


Figure 10b: Typical chromaticity coordinate shift vs. case temperature

Current De-rating

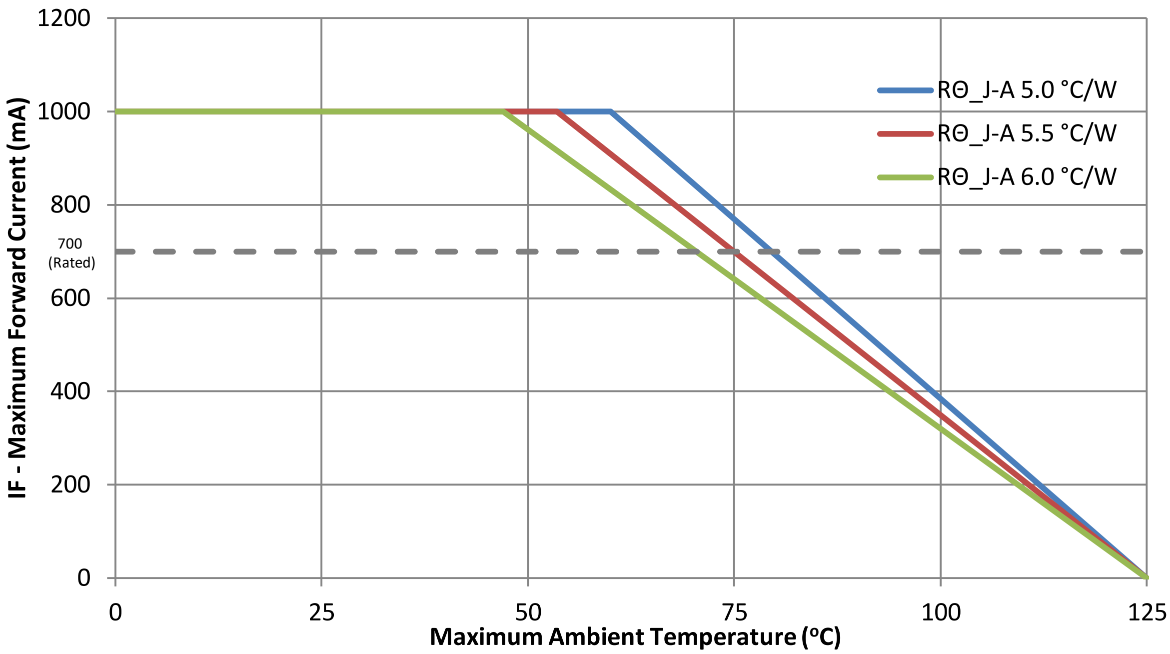


Figure 11: Maximum forward current vs. ambient temperature based on $T_{J(MAX)}$ = 125°C

Notes for Figure 11:
1. Maximum current assumes that all four LED dice are operating concurrently at the same current.
2. $R\Theta_{J-C}$ [Junction to Case Thermal Resistance] for LZ4-04MDC9 is typically 2.8°C/W.
3. $R\Theta_{J-A}$ [Junction to Ambient Thermal Resistance] = $R\Theta_{J-C}$ + $R\Theta_{C-A}$ [Case to Ambient Thermal Resistance].

Emitter Tape and Reel Specifications (mm)

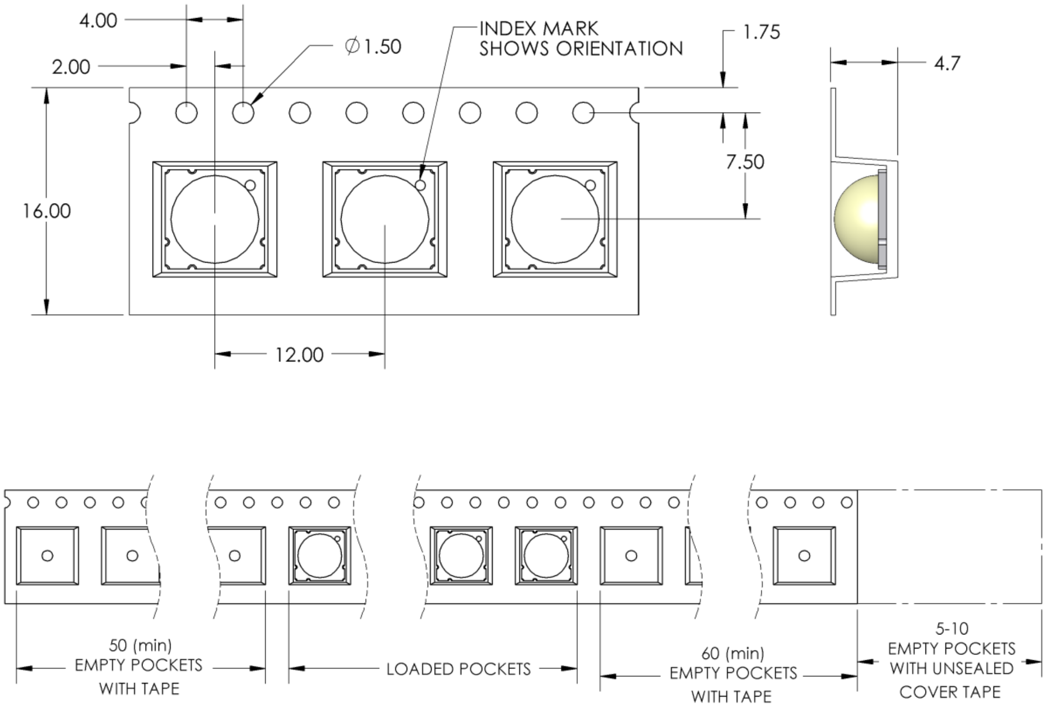


Figure 12: Emitter carrier tape specifications (mm).

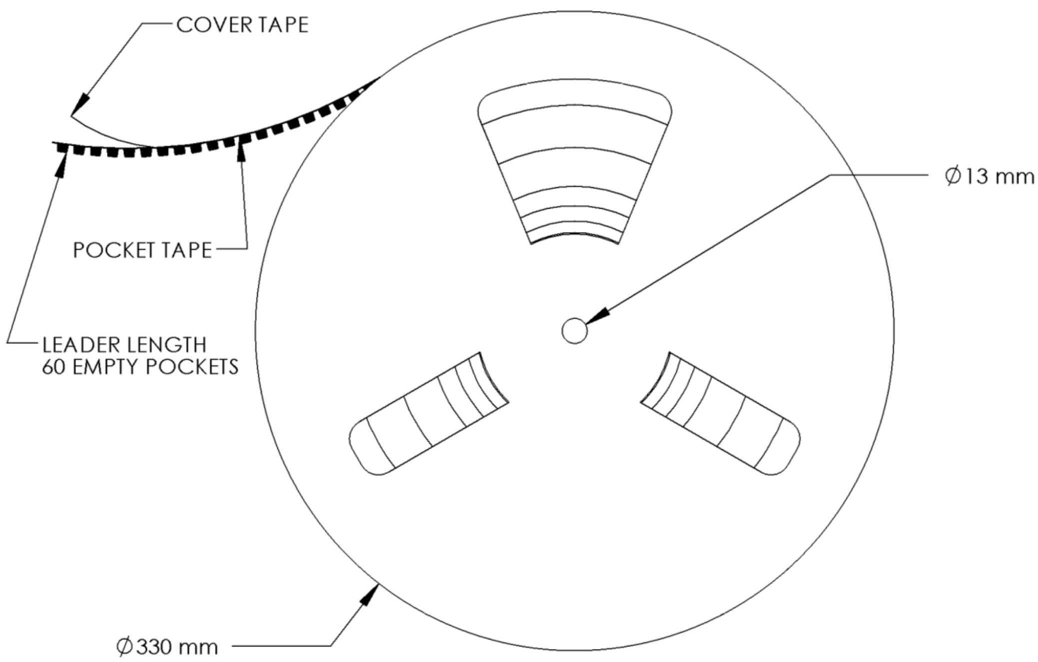


Figure 13: Emitter Reel specifications (mm).

Notes for Figure 13:

1. Small reel quantity: up to 250 emitters
2. Large reel quantity: 250-1200 emitters
3. Single flux bin and single wavelength per reel.

LZ4 MCPCB Family

Part number	Type of MCPCB	Diameter (mm)	Emitter + MCPCB Thermal Resistance (°C/W)	Typical V_f (V)	Typical I_f (mA)
LZ4-6xxxxx	4-channel	19.9	2.8 + 0.2 = 3.0	2.5 – 3.6	700

Mechanical Mounting of MCPCB

- MCPCB bending should be avoided as it will cause mechanical stress on the emitter, which could lead to substrate cracking and subsequently LED dies cracking.
- To avoid MCPCB bending:
  - Special attention needs to be paid to the flatness of the heat sink surface and the torque on the screws.
  - Care must be taken when securing the board to the heat sink. This can be done by tightening three M3 screws (or #4-40) in steps and not all the way through at once. Using fewer than three screws will increase the likelihood of board bending.
  - It is recommended to always use plastics washers in combinations with the three screws.
  - If non-taped holes are used with self-tapping screws, it is advised to back out the screws slightly after tightening (with controlled torque) and then re-tighten the screws again.

Thermal interface material

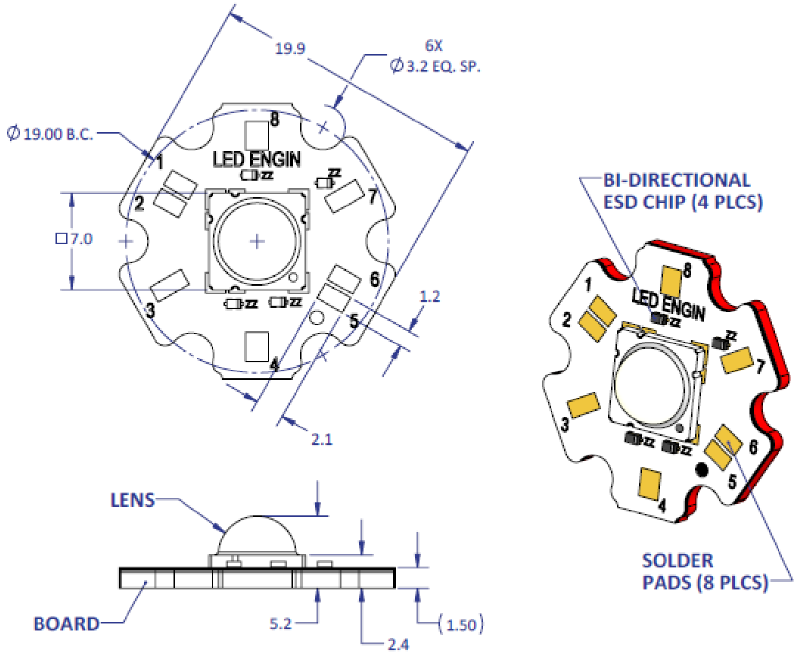
- To properly transfer heat from LED emitter to heat sink, a thermally conductive material is required when mounting the MCPCB on to the heat sink.
- There are several varieties of such material: thermal paste, thermal pads, phase change materials and thermal epoxies. An example of such material is Electrolube EHTC.
- It is critical to verify the material's thermal resistance to be sufficient for the selected emitter and its operating conditions.

Wire soldering

- To ease soldering wire to MCPCB process, it is advised to preheat the MCPCB on a hot plate of 125-150°C. Subsequently, apply the solder and additional heat from the solder iron will initiate a good solder reflow. It is recommended to use a solder iron of more than 60W.
- It is advised to use lead-free, no-clean solder. For example: SN-96.5 AG-3.0 CU 0.5 #58/275 from Kester (pn: 24-7068-7601)

LZ4-6xxxxx

4 channel, Standard Star MCPCB (4x1) Dimensions (mm)



Notes:

- Unless otherwise noted, the tolerance = ± 0.2 mm.
- Slots in MCPCB are for M3 or #4-40 mounting screws.
- LED Engin recommends plastic washers to electrically insulate screws from solder pads and electrical traces.
- LED Engin recommends using thermal interface material when attaching the MCPCB to a heatsink.
- The thermal resistance of the MCPCB is: RΘC-B 0.2°C/W

Components used

MCPCB: MHE-301 copper (Rayben)
ESD chips: BZT52C5-C10 (NXP, for 1 LED die)

Pad layout			
Ch.	MCPCB Pad	String/die	Function
1	8	1/A	Anode +
	1		Cathode -
2	6	2/B	Anode +
	3		Cathode -
3	5	3/C	Anode +
	4		Cathode -
4	7	4/D	Anode +
	2		Cathode -

About LED Engin

LED Engin, an OSRAM business based in California's Silicon Valley, develops, manufactures, and sells advanced LED emitters, optics and light engines to create uncompromised lighting experiences for a wide range of entertainment, architectural, general lighting and specialty applications. LuxiGen™ multi-die emitter and secondary lens combinations reliably deliver industry-leading flux density, upwards of 5000 quality lumens to a target, in a wide spectrum of colors including whites, tunable whites, multi-color and UV LEDs in a unique patented compact ceramic package. Our LuxiTune™ series of tunable white lighting modules leverage our LuxiGen emitters and lenses to deliver quality, control, freedom and high density tunable white light solutions for a broad range of new recessed and downlighting applications. The small size, yet remarkably powerful beam output and superior in-source color mixing, allows for a previously unobtainable freedom of design wherever high-flux density, directional light is required. LED Engin is committed to providing products that conserve natural resources and reduce greenhouse emissions; and reserves the right to make changes to improve performance without notice.

For more information, please contact LEDE-Sales@osram.com or +1 408 922-7200.