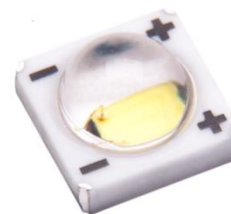


# High Luminous Efficacy Cool White LED Emitter **LZ1-00CW00**



## Key Features

- High Luminous Efficacy Cool White LED
- Ultra-small foot print – 4.4mm x 4.4mm
- Surface mount ceramic package with integrated glass lens
- Low Thermal Resistance (10°C/W)
- High Luminous Flux density
- Spatial color uniformity across radiation pattern
- New industry standard for Lumen Maintenance
- Autoclave complaint (JEDEC JESD22-A102-C)
- JEDEC Level 1 standard for Moisture Sensitivity Level
- Lead (Pb) free and RoHS compliant
- Reflow solderable (up to 6 cycles)
- Emitter available on Standard or Miniature MCPCB (optional)

## Typical Applications

- Architectural lighting
- Street lighting
- Display Backlighting
- Flashlight and Portable lighting
- Signaling
- Automotive

## Description

The LZ1-00CW00 White LED emitter provides power in an extremely small package. With a 4.4mm x 4.4mm ultra-small footprint, this package provides exceptional luminous flux density, up to 5 times greater than competitors' equivalent products. LED Engin's patent-pending thermally insulated phosphor layer provides a spatially uniform color across the radiation pattern and a consistent CCT over time and temperature. 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.

## Part number options

### Base part number

Part number	Description
LZ1-00CW00-xxxx	LZ1 emitter
LZ1-10CW00-xxxx	LZ1 emitter on Standard Star MCPCB
LZ1-30CW00-xxxx	LZ1 emitter on Miniature round MCPCB

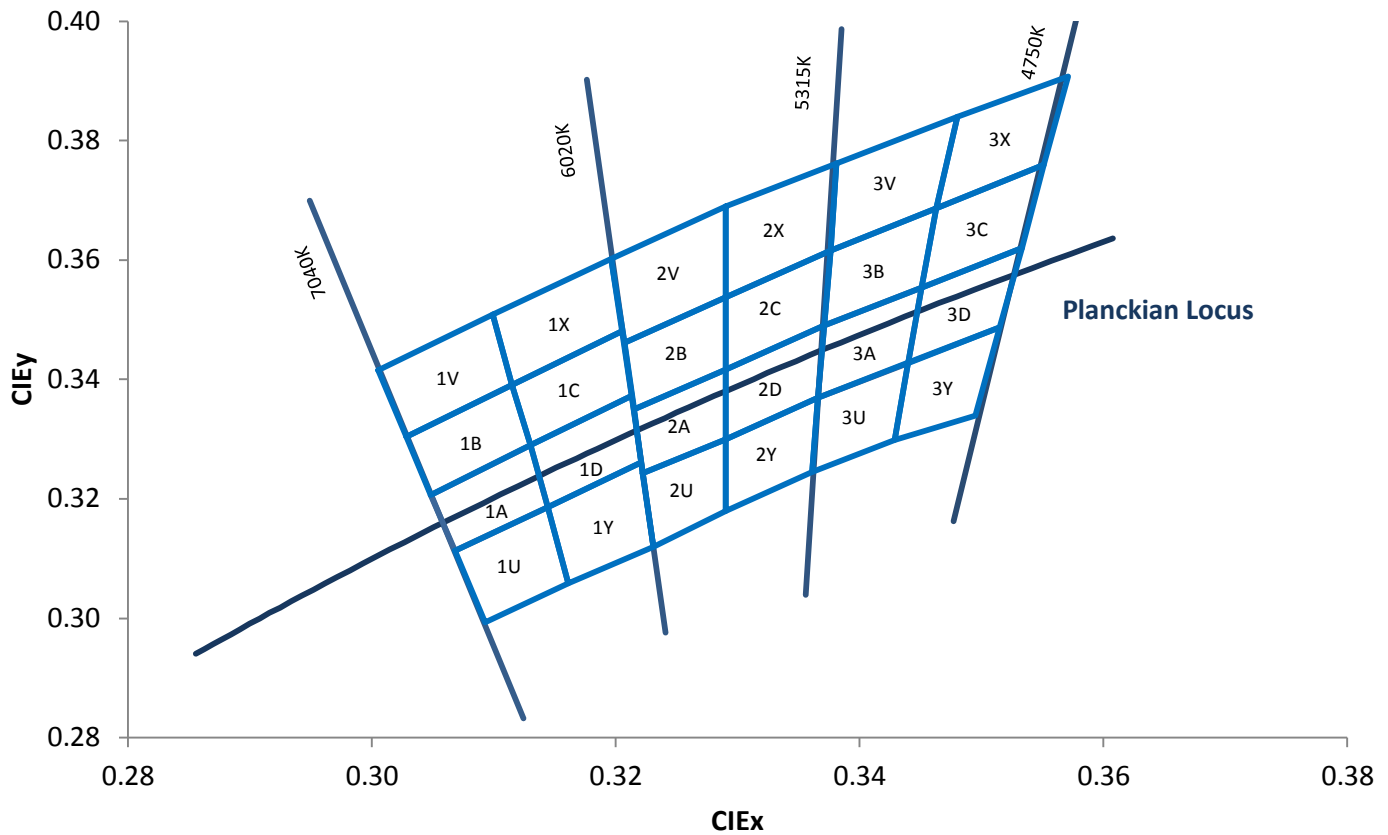
### Bin kit option codes

CW, Cool White (5000K – 6500K)			
Kit number suffix	Min flux Bin	Chromaticity bins	Description
0000	P	1U, 1A, 1B, 1V, 1Y, 1D, 1C, 1X, 2U, 2A, 2B, 2V, 2Y, 2D, 2C, 2X, 3U, 3A, 3B, 3V, 3Y, 3D, 3C, 3X	full distribution flux; full distribution CCT
0055	P	2U, 2Y, 3U, 2A, 2D, 3A, 2B, 2C, 3B, 2V, 2X, 3V	full distribution flux; 5500K bin
0065	P	1U, 1A, 1B, 1V, 1Y, 1D, 1C, 1X, 2U, 2A, 2B, 2V	full distribution flux; 6500K bin

Notes:

1. Default bin kit option is -0000

## Cool White Chromaticity Groups



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

## Cool White Bin Coordinates

Bin code	CIE <sub>x</sub>	CIE <sub>y</sub>	Bin code	CIE <sub>x</sub>	CIE <sub>y</sub>	Bin code	CIE <sub>x</sub>	CIE <sub>y</sub>	Bin code	CIE <sub>x</sub>	CIE <sub>y</sub>
1U	0.3068	0.3113	1A	0.3048	0.3207	1B	0.3028	0.3304	1V	0.3005	0.3415
	0.3144	0.3186		0.313	0.329		0.3115	0.3391		0.3099	0.3509
	0.3161	0.3059		0.3144	0.3186		0.313	0.329		0.3115	0.3391
	0.3093	0.2993		0.3068	0.3113		0.3048	0.3207		0.3028	0.3304
	0.3068	0.3113		0.3048	0.3207		0.3028	0.3304		0.3005	0.3415
1Y	0.3144	0.3186	1D	0.313	0.329	1C	0.3115	0.3391	1X	0.3099	0.3509
	0.3221	0.3261		0.3213	0.3373		0.3205	0.3481		0.3196	0.3602
	0.3231	0.312		0.3221	0.3261		0.3213	0.3373		0.3205	0.3481
	0.3161	0.3059		0.3144	0.3186		0.313	0.329		0.3115	0.3391
	0.3144	0.3186		0.313	0.329		0.3115	0.3391		0.3099	0.3509
2U	0.3222	0.3243	2A	0.3215	0.335	2B	0.3207	0.3462	2V	0.3196	0.3602
	0.329	0.33		0.329	0.3417		0.329	0.3538		0.329	0.369
	0.329	0.318		0.329	0.33		0.329	0.3417		0.329	0.3538
	0.3231	0.312		0.3222	0.3243		0.3215	0.335		0.3207	0.3462
	0.3222	0.3243		0.3215	0.335		0.3207	0.3462		0.3196	0.3602
2Y	0.329	0.33	2D	0.329	0.3417	2C	0.329	0.3538	2X	0.329	0.369
	0.3366	0.3369		0.3371	0.349		0.3376	0.3616		0.3381	0.3762
	0.3361	0.3245		0.3366	0.3369		0.3371	0.349		0.3376	0.3616
	0.329	0.318		0.329	0.33		0.329	0.3417		0.329	0.3538
	0.329	0.33		0.329	0.3417		0.329	0.3538		0.329	0.369
3U	0.3366	0.3369	3A	0.3371	0.349	3B	0.3376	0.3616	3V	0.3381	0.3762
	0.344	0.3428		0.3451	0.3554		0.3463	0.3687		0.348	0.384
	0.3429	0.3299		0.344	0.3427		0.3451	0.3554		0.3463	0.3687
	0.3361	0.3245		0.3366	0.3369		0.3371	0.349		0.3376	0.3616
	0.3366	0.3369		0.3371	0.349		0.3376	0.3616		0.3381	0.3762
3Y	0.344	0.3428	3D	0.3451	0.3554	3C	0.3463	0.3687	3X	0.348	0.384
	0.3515	0.3487		0.3533	0.362		0.3551	0.376		0.3571	0.3907
	0.3495	0.3339		0.3515	0.3487		0.3533	0.362		0.3551	0.376
	0.3429	0.3299		0.344	0.3427		0.3451	0.3554		0.3463	0.3687
	0.344	0.3428		0.3451	0.3554		0.3463	0.3687		0.348	0.384

## Luminous Flux Bins

Table 1:

<b>Bin Code</b>	<b>Minimum Luminous Flux (<math>\Phi_V</math>) @ <math>I_F = 1000\text{mA}</math> <sup>[1,2]</sup> (lm)</b>	<b>Maximum Luminous Flux (<math>\Phi_V</math>) @ <math>I_F = 1000\text{mA}</math> <sup>[1,2]</sup> (lm)</b>	<b>Typical Luminous Flux (<math>\Phi_V</math>) @ <math>I_F = 1200\text{mA}</math> <sup>[2]</sup> (lm)</b>
P	182	228	229
Q	228	285	282

Notes for Table 1:

1. Luminous flux performance guaranteed within published operating conditions. LED Engin maintains a tolerance of  $\pm 10\%$  on flux measurements.
2. Future products will have even higher levels of luminous flux performance. Contact LED Engin Sales for updated information.

## Forward Voltage Bins

Table 2:

<b>Bin Code</b>	<b>Minimum Forward Voltage (<math>V_F</math>) @ <math>I_F = 1000\text{mA}</math> <sup>[1]</sup> (V)</b>	<b>Maximum Forward Voltage (<math>V_F</math>) @ <math>I_F = 1000\text{mA}</math> <sup>[1]</sup> (V)</b>
0	3.20	4.2

Notes for Table 2:

1. LED Engin maintains a tolerance of  $\pm 0.04\text{V}$  for forward voltage measurements.

## Absolute Maximum Ratings

Table 3:

Parameter	Symbol	Value	Unit
DC Forward Current at $T_{jmax}=135^{\circ}\text{C}$ <sup>[1]</sup>	$I_F$	1200	mA
DC Forward Current at $T_{jmax}=150^{\circ}\text{C}$ <sup>[1]</sup>	$I_F$	1000	mA
Peak Pulsed Forward Current <sup>[2]</sup>	$I_{FP}$	2000	mA
Reverse Voltage	$V_R$	See Note 3	V
Storage Temperature	$T_{stg}$	-40 ~ +150	$^{\circ}\text{C}$
Junction Temperature	$T_J$	150	$^{\circ}\text{C}$
Soldering Temperature <sup>[4]</sup>	$T_{sol}$	260	$^{\circ}\text{C}$
Allowable Reflow Cycles		6	
Autoclave Conditions <sup>[5]</sup>		121 $^{\circ}\text{C}$ at 2 ATM, 100% RH for 168 hours	
ESD Sensitivity <sup>[6]</sup>		> 8,000 V HBM Class 3B JESD22-A114-D	

Notes for Table 3:

- Maximum DC forward current is determined by the overall thermal resistance and ambient temperature. Follow the curves in Figure 10 for current derating.
- Pulse forward current conditions: Pulse Width  $\leq 10\text{msec}$  and Duty cycle  $\leq 10\%$ .
- LEDs are not designed to be reverse biased.
- Solder conditions per JEDEC 020D. See Reflow Soldering Profile Figure 5.
- Autoclave Conditions per JEDEC JESD22-A102-C.
- LED Engin recommends taking reasonable precautions towards possible ESD damages and handling the LZ1-00CW00 in an electrostatic protected area (EPA). An EPA may be adequately protected by ESD controls as outlined in ANSI/ESD S6.1.

## Optical Characteristics @ $T_C = 25^{\circ}\text{C}$

Table 4:

Parameter	Symbol	Typical	Unit
Luminous Flux (@ $I_F = 1000\text{mA}$ )	$\Phi_V$	227	lm
Luminous Efficacy (@ $I_F = 350\text{mA}$ )		90	lm/W
Correlated Color Temperature	CCT	5500	K
Color Rendering Index (CRI)	$R_a$	75	
Viewing Angle <sup>[1]</sup>	$2\theta_{1/2}$	85	Degrees
Total Included Angle <sup>[2]</sup>	$\theta_{0.9V}$	125	Degrees

Notes for Table 4:

- Viewing Angle is the off axis angle from emitter centerline where the luminous intensity is  $\frac{1}{2}$  of the peak value.
- Total Included Angle is the total angle that includes 90% of the total luminous flux.

## Electrical Characteristics @ $T_C = 25^{\circ}\text{C}$

Table 5:

Parameter	Symbol	Typical	Unit
Forward Voltage (@ $I_F = 1000\text{mA}$ )	$V_F$	3.6	V
Forward Voltage (@ $I_F = 1200\text{mA}$ )	$V_F$	3.7	V
Temperature Coefficient of Forward Voltage	$\Delta V_F / \Delta T_J$	-2.8	mV/ $^{\circ}\text{C}$
Thermal Resistance (Junction to Case)	$R\theta_{J-C}$	10	$^{\circ}\text{C}/\text{W}$

## IPC/JEDEC Moisture Sensitivity Level

Table 6 - IPC/JEDEC J-STD-20D.1 MSL Classification:

Level	Floor Life		Soak Requirements			
	Time	Conditions	Standard	Conditions	Accelerated	Conditions
1	Unlimited	$\leq 30^{\circ}\text{C}/$ 85% RH	168 +5/-0	$85^{\circ}\text{C}/$ 85% RH	n/a	n/a

Notes for Table 6:

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 65000 hours of operation at a forward current of 1000 mA. This projection is based on constant current operation with junction temperature maintained at or below 125°C.

## Mechanical Dimensions (mm)

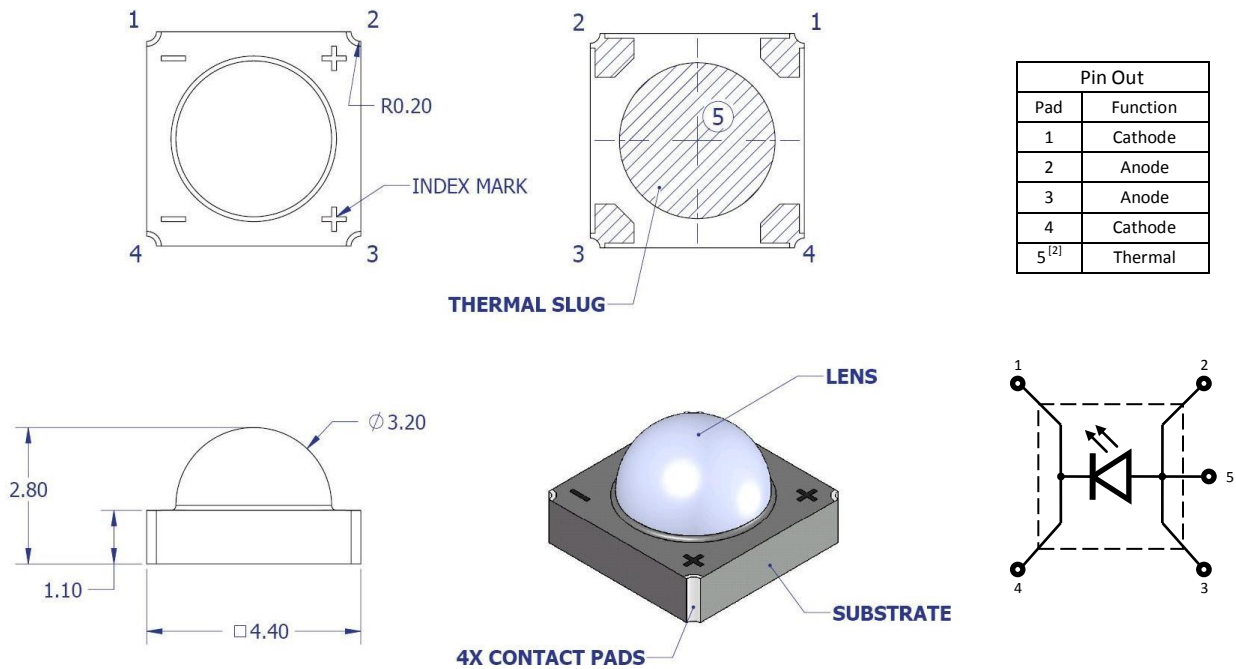


Figure 1: Package outline drawing.

Notes for Figure 1:

1. Unless otherwise noted, the tolerance =  $\pm 0.20$  mm.
2. Thermal contact, Pad 5, is electrically connected to the Anode, Pads 2 and 3. Do not connect any pad to the thermal contact, Pad # 5. When mounting the LZ1-00CW00 onto a MCPCB, by default its dielectric layer provides for the necessary electrical insulation in between all contact pads. LED Engin offers LZ1-10CW00 and LZ1-30CW00 MCPCB options which provide for electrical insulation between all contact pads. Please refer to Application Note MCPCB Option 1 and Option 3, or contact a LED Engin sales representative for more information.

## Recommended Solder Pad Layout (mm)

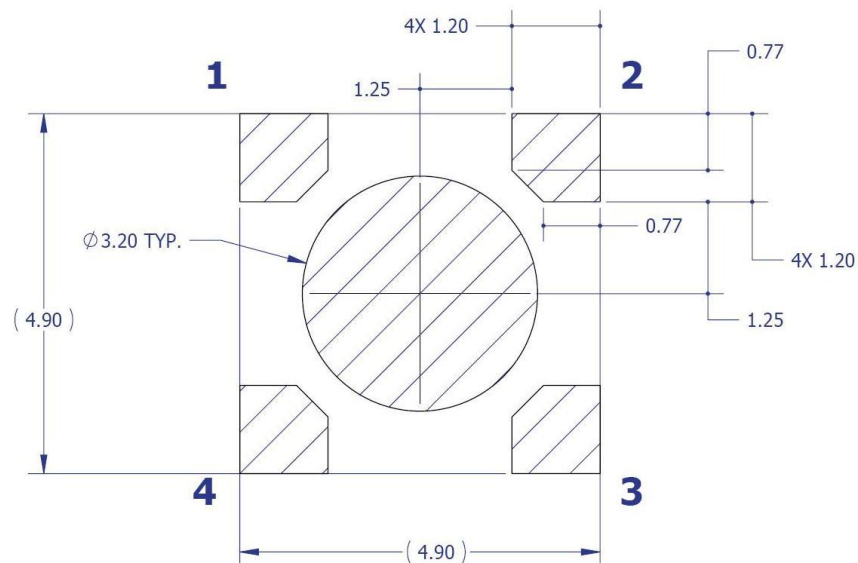


Figure 2: Recommended solder mask opening (hatched area) for anode, cathode, and thermal pad.

Note for Figure 2:

1. Unless otherwise noted, the tolerance =  $\pm 0.20$  mm.



## Reflow Soldering Profile

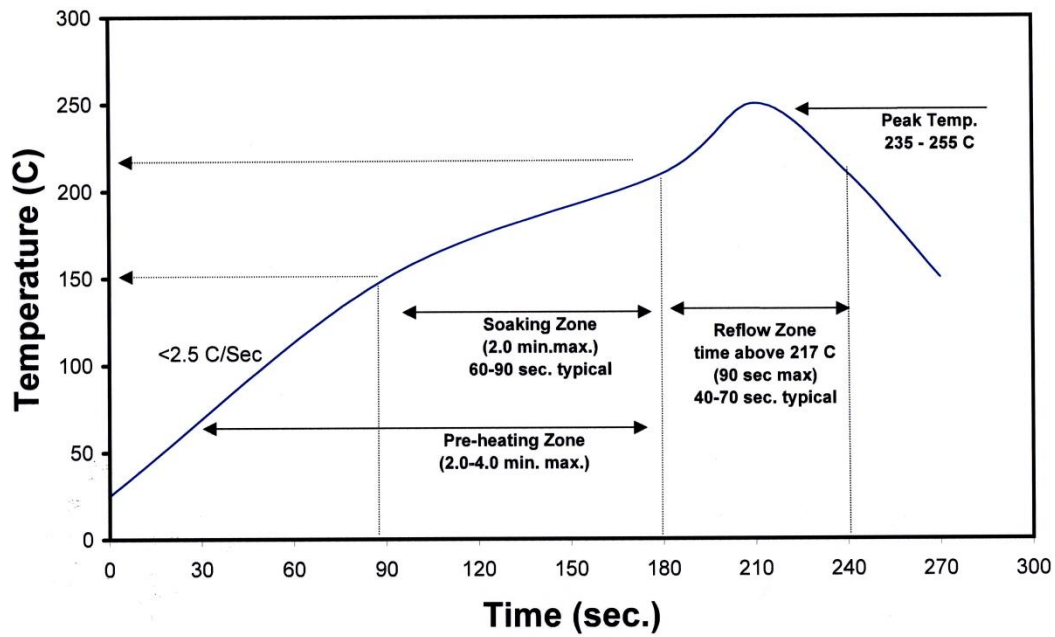


Figure 3: Reflow soldering profile for lead free soldering.

## Typical Radiation Pattern

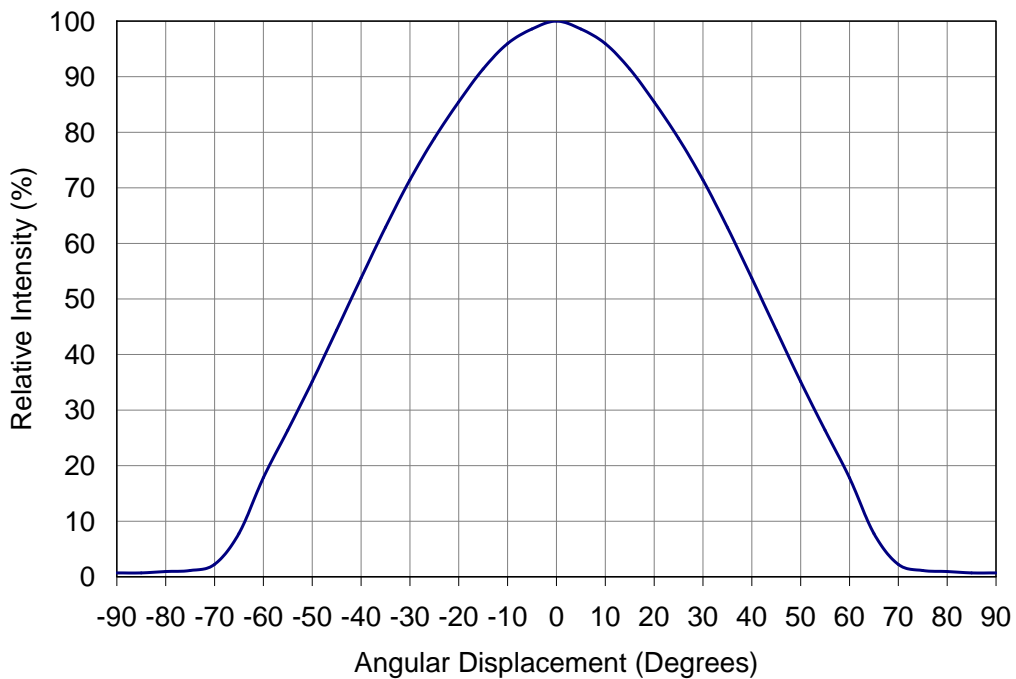


Figure 4: Typical representative spatial radiation pattern.

## Typical Relative Spectral Power Distribution

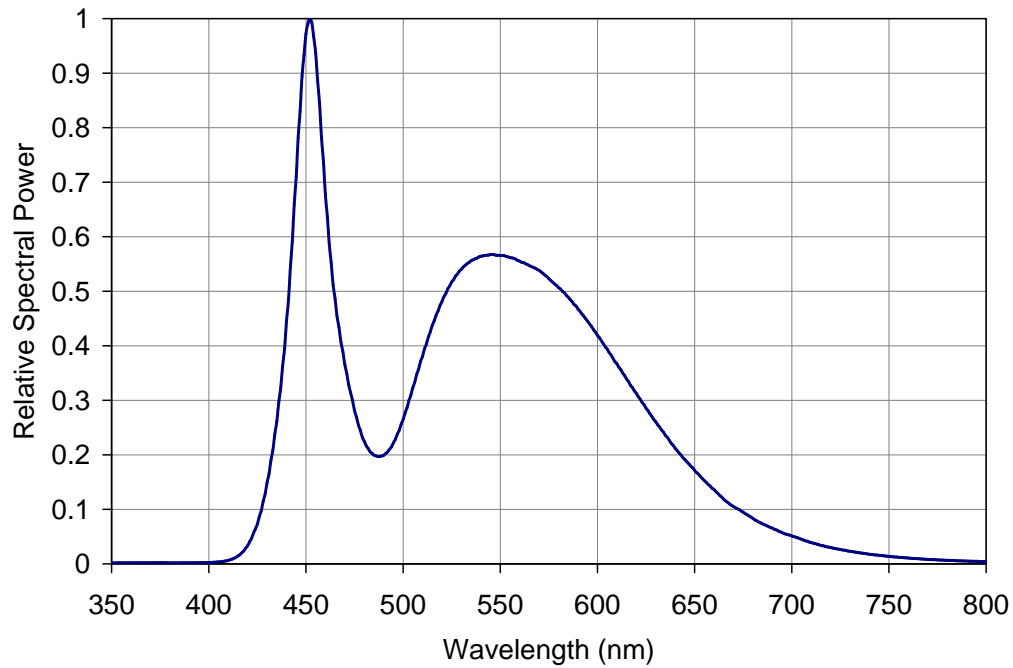


Figure 5: Relative spectral power vs. wavelength @  $T_c = 25^\circ\text{C}$ .

## Typical Relative Light Output

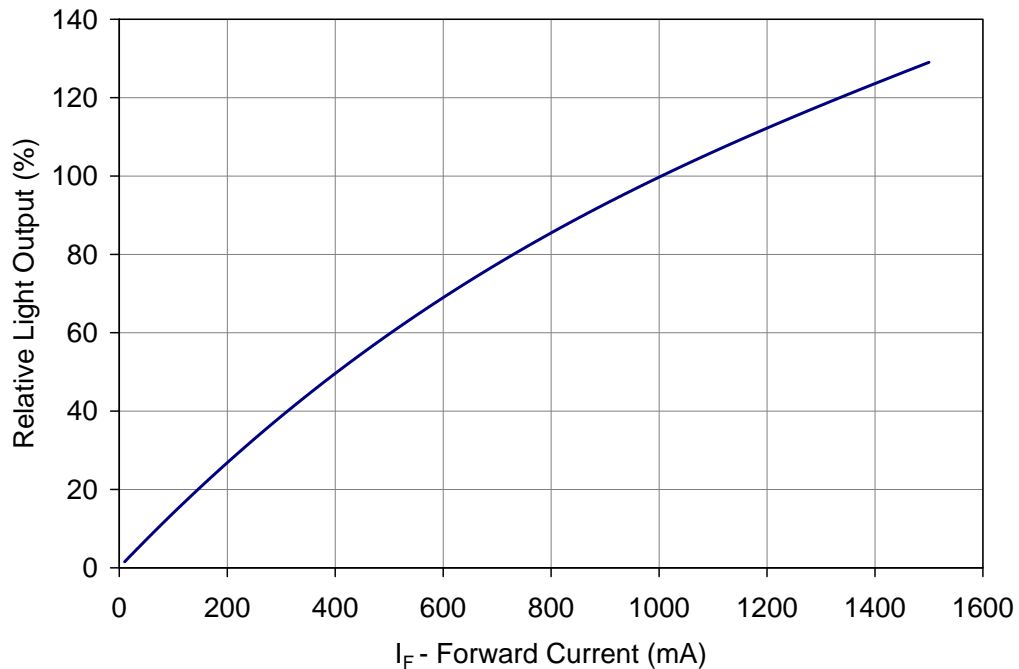


Figure 6: Typical relative light output vs. forward current @  $T_c = 25^\circ\text{C}$ .

## Typical Relative Light Output over Temperature

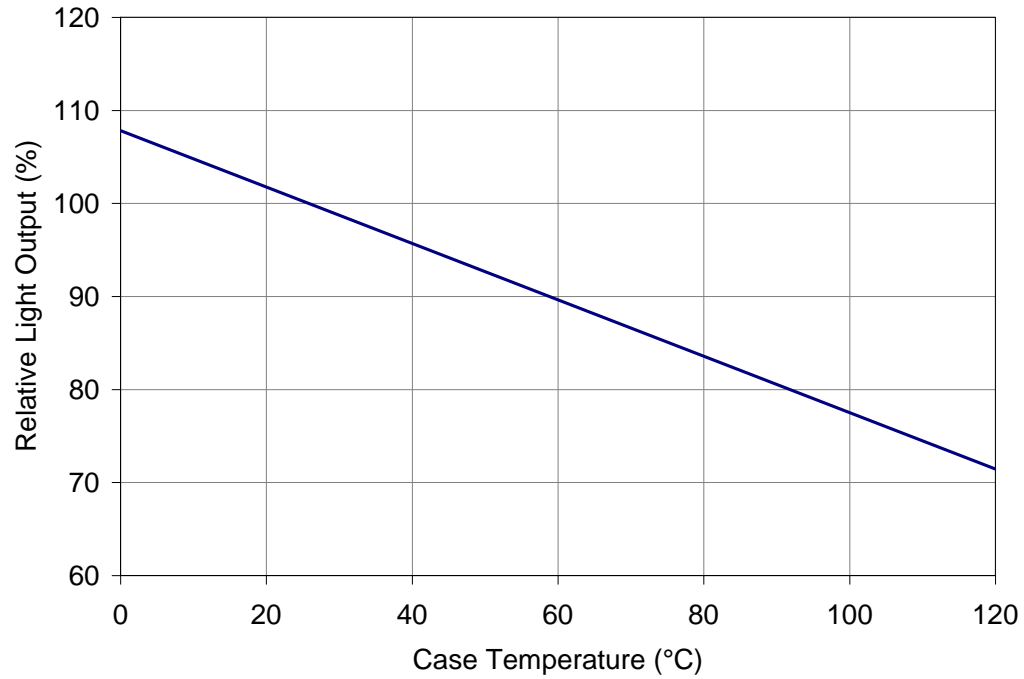


Figure 7: Typical relative light output vs. case temperature.

## Typical Forward Current Characteristics

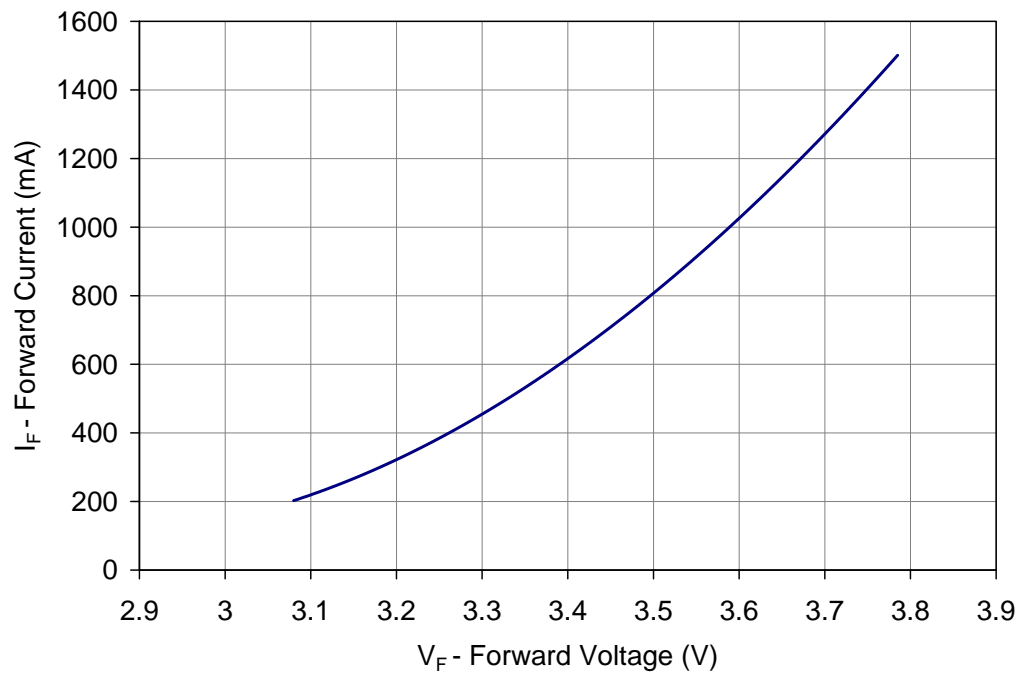


Figure 8: Typical forward current vs. forward voltage @ T<sub>C</sub> = 25°C.

## Current De-rating

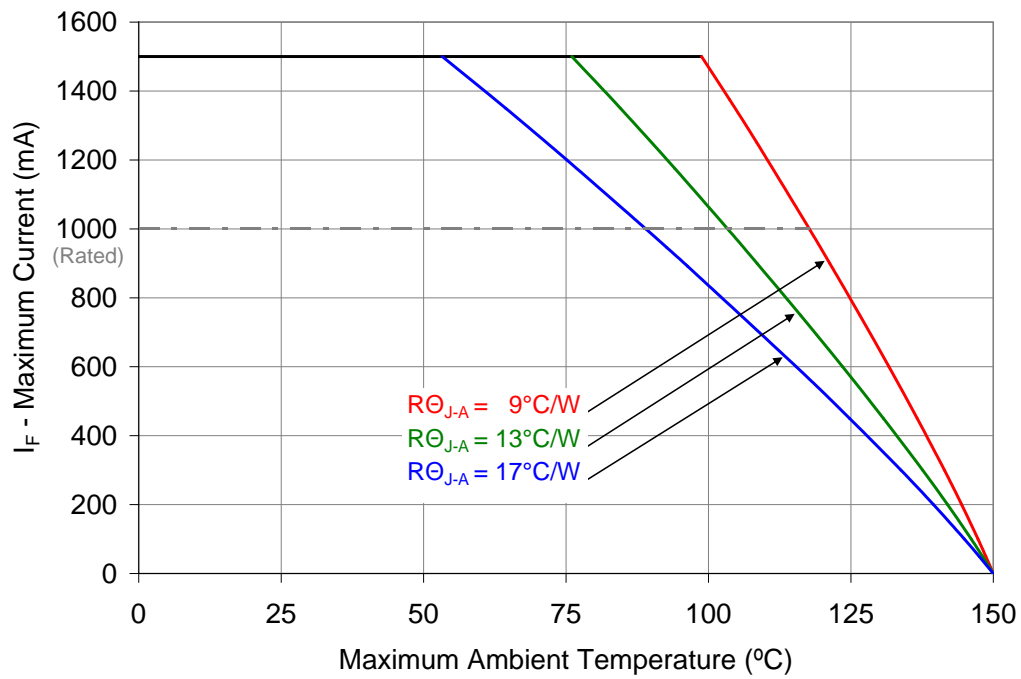


Figure 9: Maximum forward current vs. ambient temperature based on  $T_{J(\text{MAX})} = 150^{\circ}\text{C}$ .

Notes for Figure 9:

1.  $R\theta_{J-C}$  [Junction to Case Thermal Resistance] for the LZ1-00CW00 is typically  $10^{\circ}\text{C/W}$ .
2.  $R\theta_{J-A}$  [Junction to Ambient Thermal Resistance] =  $R\theta_{J-C} + R\theta_{C-A}$  [Case to Ambient Thermal Resistance].

## Emitter Tape and Reel Specifications (mm)

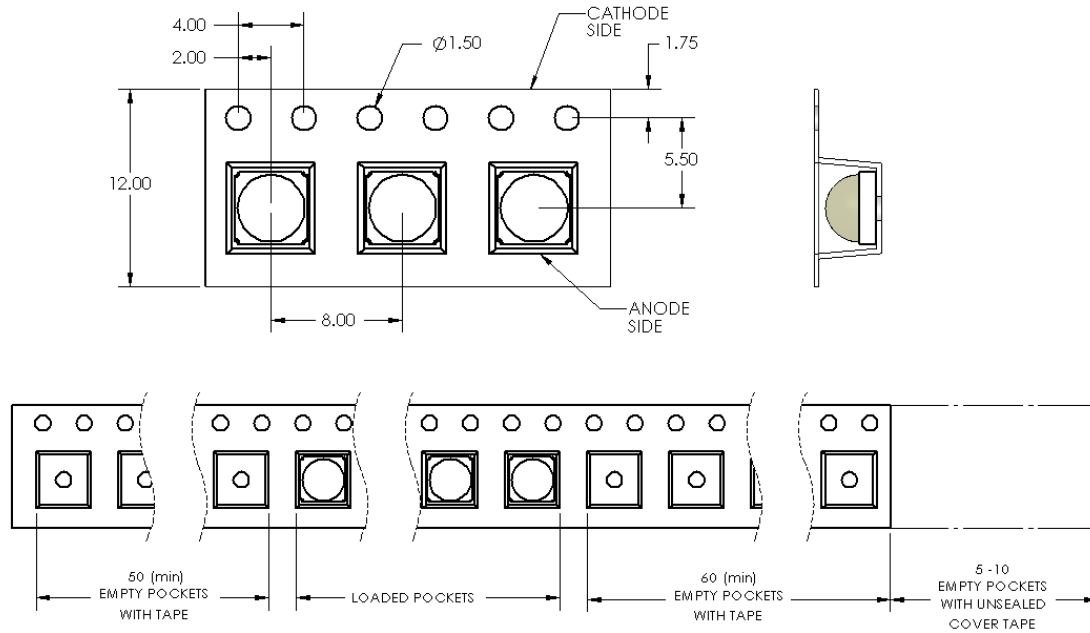


Figure 10: Emitter carrier tape specifications (mm).

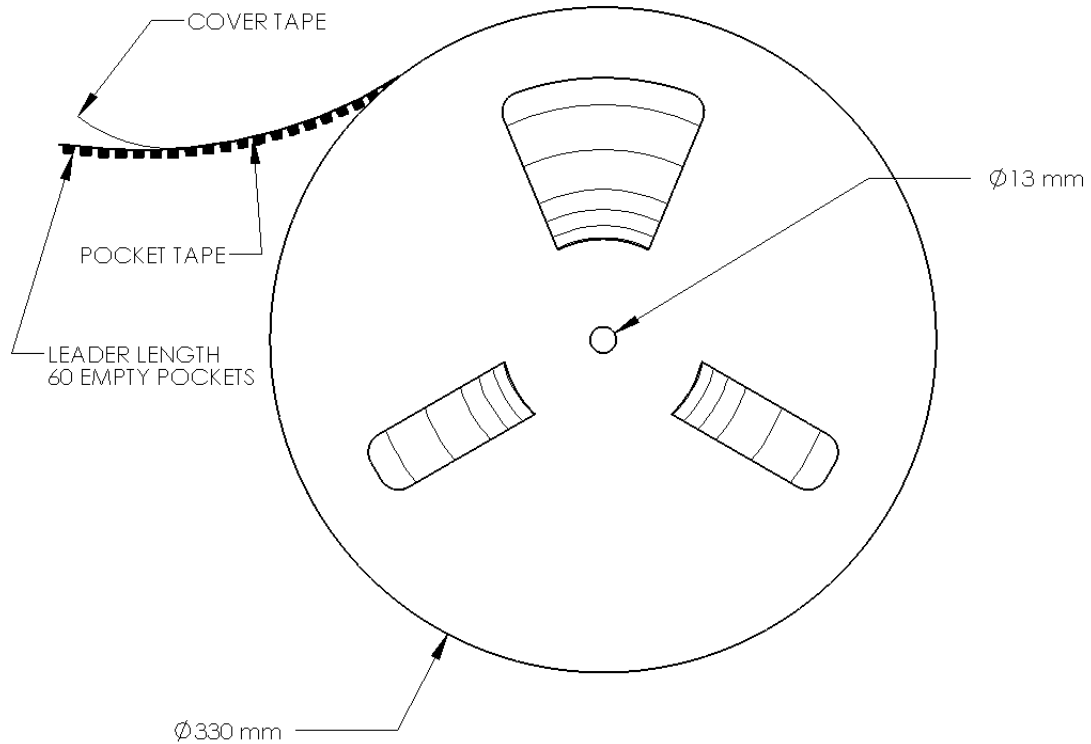


Figure 11: Emitter reel specifications (mm).

# LZ1 MCPCB Family

Part number	Type of MCPCB	Diameter (mm)	Emitter + MCPCB Thermal Resistance (°C/W)	Typical $V_f$ (V)	Typical $I_f$ (mA)
<b>LZ1-1xxxxxx</b>	1-channel Star	19.9	$10.5 + 1.5 = 12.0$	3.6	1000
<b>LZ1-3xxxxxx</b>	1-channel Mini	11.5	$10.5 + 2.0 = 12.5$	3.6	1000

## 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

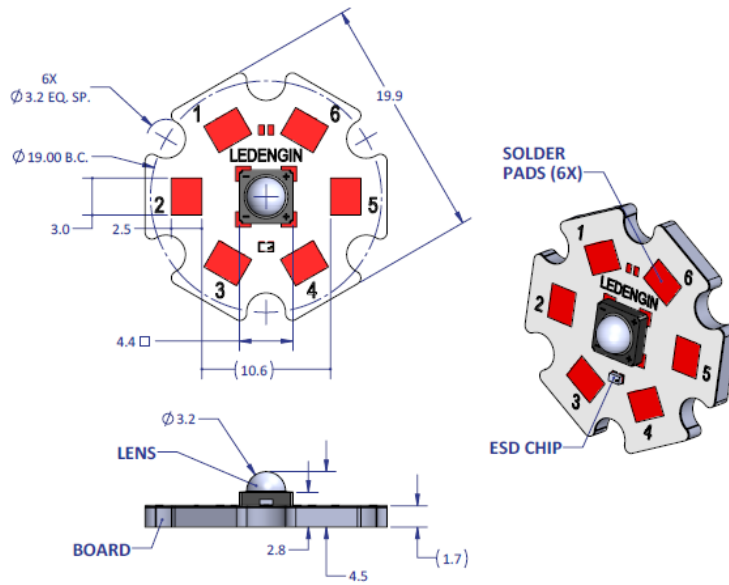
- To properly transfer heat from LED emitter to heat sink, a thermally conductive material is required when mounting the MCPCB on to the heat sink.
- There are several varieties of such material: thermal paste, thermal pads, phase change materials and thermal epoxies. An example of such material is Electrolube 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)

# LZ1-1xxxxx

## 1 channel, Standard Star MCPCB (1x1) Dimensions (mm)



### Notes:

- Unless otherwise noted, the tolerance =  $\pm 0.2$  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 heat sink.
- The thermal resistance of the MCPCB is:  $R_{\theta C-B}$  1.5°C/W

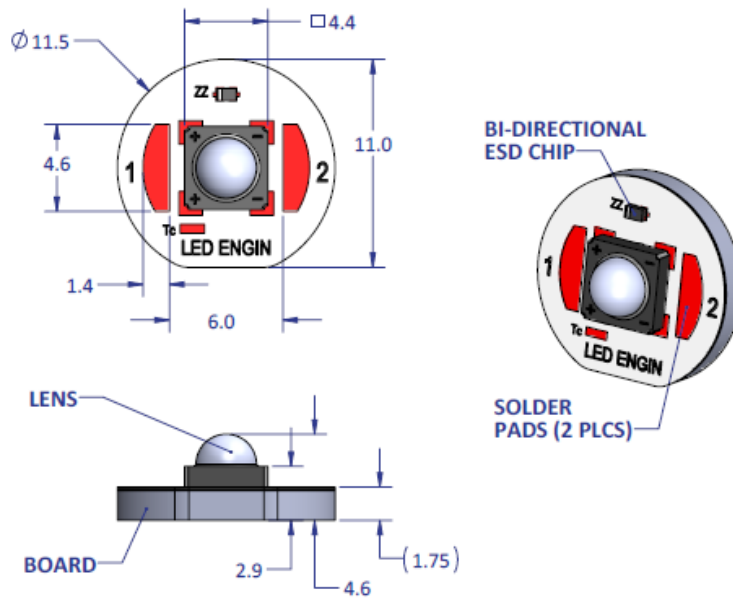
## Components used

MCPCB:	HT04503	(Bergquist)
ESD/TVS Diode:	BZT52C5V1LP-7	(Diodes, Inc., for 1 LED die)
	VBUS05L1-DD1	(Vishay Semiconductors, for 1 LED die)

Pad layout			
Ch.	MCPCB Pad	String/die	Function
1	1,2,3	1/A	Cathode -
	4,5,6		Anode +

# LZ1-3xxxxx

## 1 channel, Mini Round MCPCB (1x1) Dimensions (mm)



### Notes:

- Unless otherwise noted, the tolerance =  $\pm 0.20$  mm.
- LED Engin recommends using thermal interface material when attaching the MCPCB to a heat sink.
- The thermal resistance of the MCPCB is:  $\theta_{JC-B} 2.0^{\circ}\text{C/W}$

## Components used

MCPCB:	HT04503	(Bergquist)
ESD/TVS Diode:	BZT52C5V1LP-7	(Diodes, Inc., for 1 LED die)
	VBUS05L1-DD1	(Vishay Semiconductors, for 1 LED die)

Pad layout			
Ch.	MCPCB Pad	String/die	Function
1	1	1/A	Anode +
	2		Cathode -



## Company Information

LED Engin, 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.

LED Engin reserves the right to make changes to improve performance without notice.

Please contact [sales@ledengin.com](mailto:sales@ledengin.com) or (408) 922-7200 for more information.

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