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LED ENGIN
BRIGHT LIGHT. TINY PACKAGE.

PRELIMINARY

High Luminous Efficacy Neutral White LED Emitter

LZ1-00NW02

Photo TBD

Key Features

- High Luminous Efficacy Neutral White LED
- Ultra-small foot print – 4.4mm x 4.4mm
- Single 4000K ANSI bin distribution
- Surface mount ceramic package with integrated glass lens
- Low Thermal Resistance (6.0°C/W)
- High Luminous Flux density
- Spatial color uniformity across radiation pattern
- JEDEC Level 1 for Moisture Sensitivity Level
- Lead (Pb) free and RoHS compliant
- Reflow solderable
- Emitter available on Standard or Miniature MCPCB (optional)

Typical Applications

- General lighting
- Commercial Refrigeration
- Office lighting
- Retail & high-end interior lighting
- Accent & Task lighting
- Architectural Detail lighting

Description

The LZ1-00NW02 Neutral 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. 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.

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Part number options

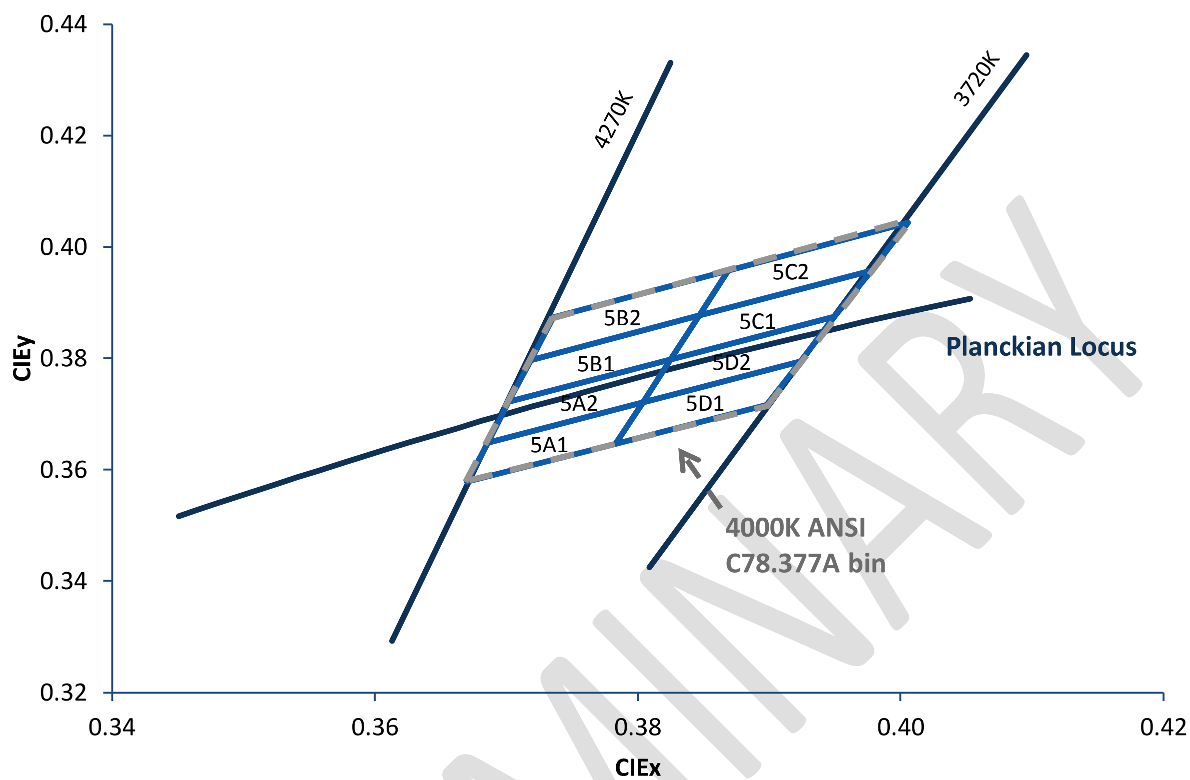
Base part number

Part number	Description
LZ1-00NW02-xxxx	LZ1 emitter
LZ1-10NW02-xxxx	LZ1 emitter on Standard Star MCPCB

Bin kit option codes

NW, Neutral White (4000K – 4500K)			
Kit number suffix	**Min flux Bin**	**Chromaticity bins**	**Description**
0040	N	5B2, 5C2, 5B1, 5C1, 5A2, 5D2, 5A1, 5D1	full distribution flux; 4000K ANSI CCT bin
P040	P	5B2, 5C2, 5B1, 5C1, 5A2, 5D2, 5A1, 5D1	P=minimum flux bin; 4000K ANSI CCT bin

Neutral 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.

Neutral White Bin Coordinates

Bin code	CIEx	CIEy	Bin code	CIEx	CIEy
	0.3719	0.3797		0.3847	0.3877
	0.3736	0.3874		0.3869	0.3958
5B2	0.3869	0.3958	5C2	0.4006	0.4044
	0.3847	0.3877		0.3978	0.3958
	0.3719	0.3797		0.3847	0.3877
	0.3702	0.3722		0.3825	0.3798
	0.3719	0.3797		0.3847	0.3877
5B1	0.3847	0.3877	5C1	0.3978	0.3958
	0.3825	0.3798		0.395	0.3875
	0.3702	0.3722		0.3825	0.3798
	0.3686	0.3649		0.3804	0.3721
	0.3702	0.3722		0.3825	0.3798
5A2	0.3825	0.3798	5D2	0.395	0.3875
	0.3804	0.3721		0.3924	0.3794
	0.3686	0.3649		0.3804	0.3721
	0.367	0.3578		0.3783	0.3646
	0.3686	0.3649		0.3804	0.3721
5A1	0.3804	0.3721	5D1	0.3924	0.3794
	0.3783	0.3646		0.3898	0.3716
	0.367	0.3578		0.3783	0.3646

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Luminous Flux Bins

Table 1:

Bin Code	Minimum Luminous Flux (Φ_V) @ I_F = 1000mA [1,2] (lm)	Maximum Luminous Flux (Φ_V) @ I_F = 1000mA [1,2] (lm)	Typical Luminous Flux (Φ_V) @ I_F = 1200mA [2] (lm)
N	146	182	189
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 ± 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:

Bin Code	Minimum Forward Voltage (V_F) @ I_F = 1000mA [1] (V)	Maximum Forward Voltage (V_F) @ I_F = 1000mA [1] (V)
0	3.20	4.20

Notes for Table 2:
1. LED Engin maintains a tolerance of ± 0.04V for forward voltage measurements.

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Absolute Maximum Ratings

Table 3:

Parameter	Symbol	Value	Unit
DC Forward Current at $T_{J(MAX)}$=135°C [1]	I_F	1200	mA
DC Forward Current at $T_{J(MAX)}$=150°C [1]	I_F	1000	mA
Peak Pulsed Forward Current [2]	I_{FP}	2000	mA
Reverse Voltage	V_R	See Note 3	V
Storage Temperature	T_{stg}	-40 ~ +150	°C
Junction Temperature	T_J	150	°C
Soldering Temperature [4]	T_{sol}	260	°C

Notes for Table 3:

1. Maximum DC forward current is determined by the overall thermal resistance and ambient temperature. Follow the curves in Figure 10 for current derating.
2: Pulse forward current conditions: Pulse Width ≤ 10msec and Duty Cycle ≤ 10%.
3. LEDs are not designed to be reverse biased.
4. Solder conditions per JEDEC J-STD-020D. See Reflow Soldering Profile Figure 3.
5. LED Engin recommends taking reasonable precautions towards possible ESD damages and handling the LZ1-00NW02 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 4:

Parameter	Symbol	Typical	Unit
Luminous Flux (@ I_F = 1000mA)	Φ_V	200	lm
Luminous Efficacy (@ I_F = 350mA)	η	80	lm/W
Correlated Color Temperature	CCT	4000	K
Color Rendering Index (CRI) [1]	R_a	82	
Viewing Angle [2]	$2\Theta_{1/2}$	TBD	Degrees
Total Included Angle [3]	$\Theta_{0.9V}$	TBD	Degrees

Notes for Table 4:

1. Minimum Color Rendering Index (CRI) is 80.
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 5:

Parameter	Symbol	Typical	Unit
Forward Voltage (@ I_F = 1000mA)	V_F	3.6	V
Forward Voltage (@ I_F = 1200mA)	V_F	3.7	V
Temperature Coefficient of Forward Voltage	$\Delta V_F/\Delta T_J$	-2.8	mV/°C
Thermal Resistance (Junction to Case)	$R\Theta_{J-C}$	6.0	°C/W

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IPC/JEDEC Moisture Sensitivity Level

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

	Floor Life		Soak Requirements Standard		Soak Requirements 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 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 65,000 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.

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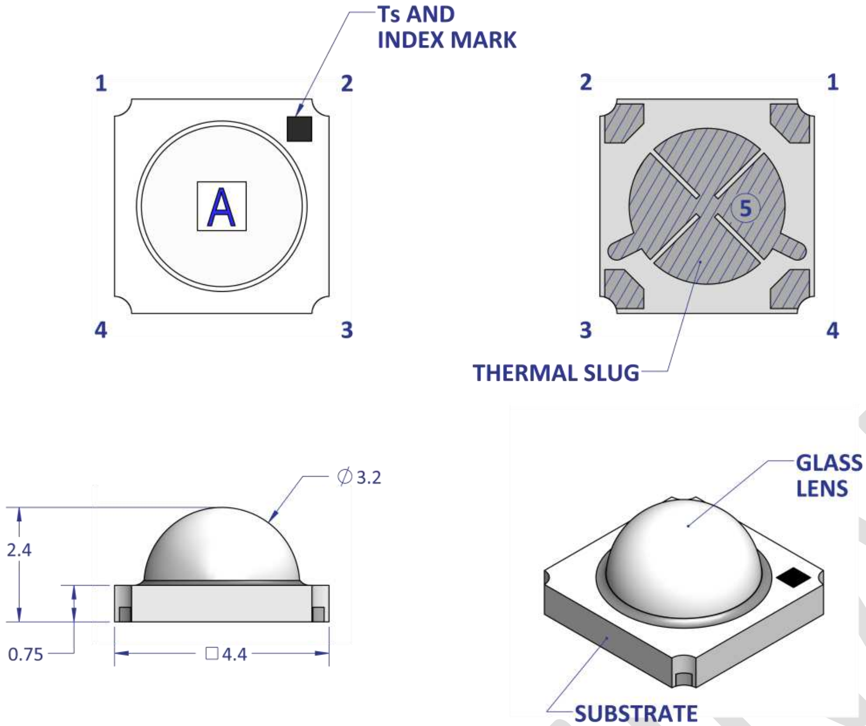
Mechanical Dimensions (mm)



Pin Out	
Pad	Function
1	Anode
2	Cathode
3	Cathode
4	Anode
5 [2]	Thermal

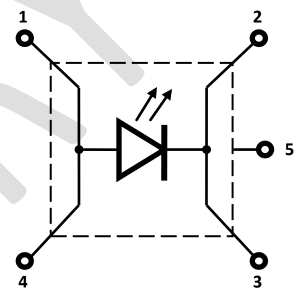


Figure 1: Package outline drawing

Notes for Figure 1:
1. Unless otherwise noted, the tolerance = ± 0.20 mm.
2. Thermal contact, Pad 5, is electrically neutral.

Recommended Solder Pad Layout (mm)

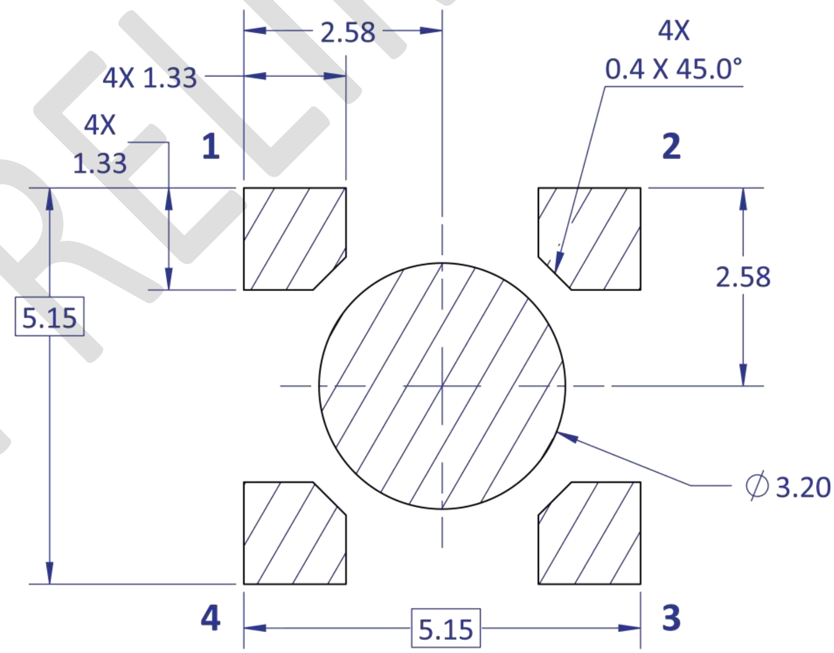


Figure 2a: Recommended solder pad layout for anode, cathode, and thermal pad

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

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Recommended Solder Mask Layout (mm)

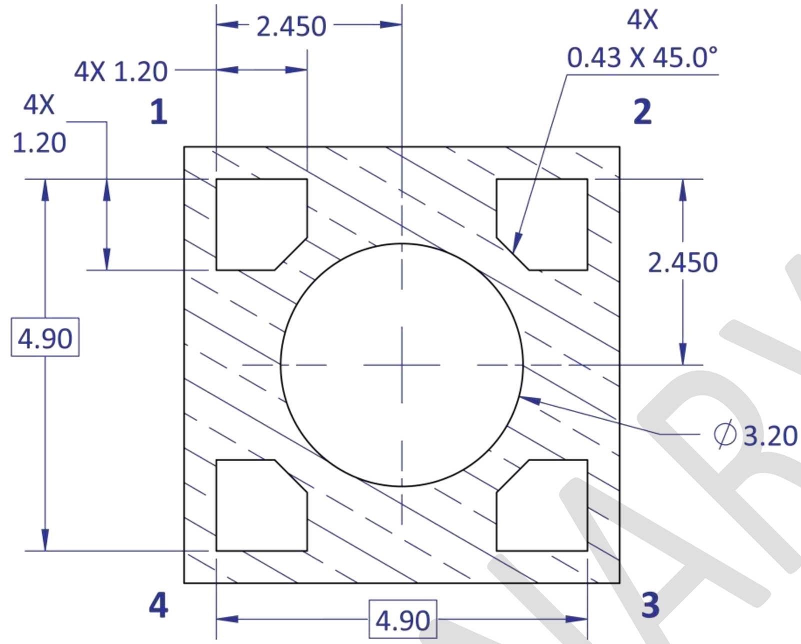

Figure 2b: Recommended solder mask opening for anode, cathode, and thermal pad

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

Recommended 8mil Stencil Apertures Layout (mm)

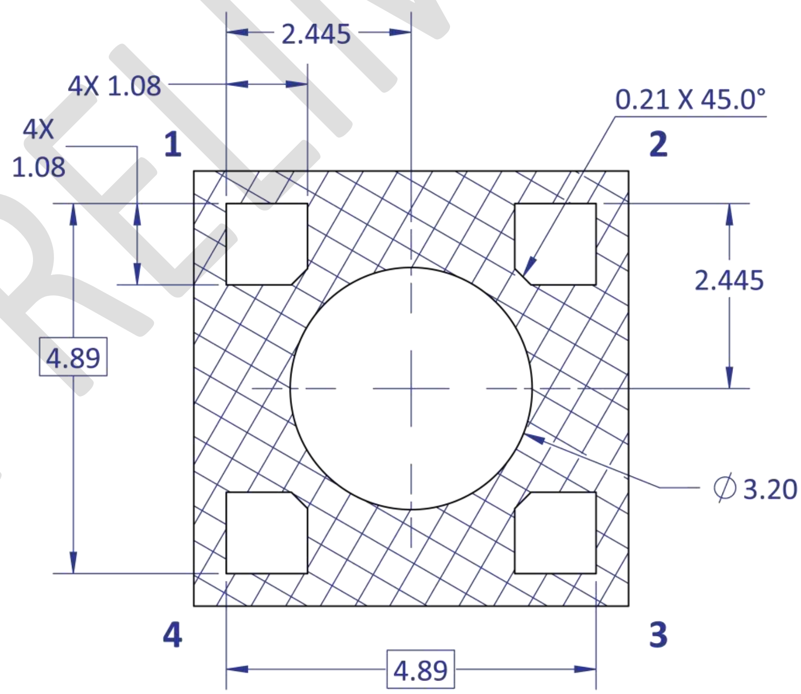

Figure 2c: Recommended 8mil stencil apertures layout for anode, cathode, and thermal pad

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

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Reflow Soldering Profile

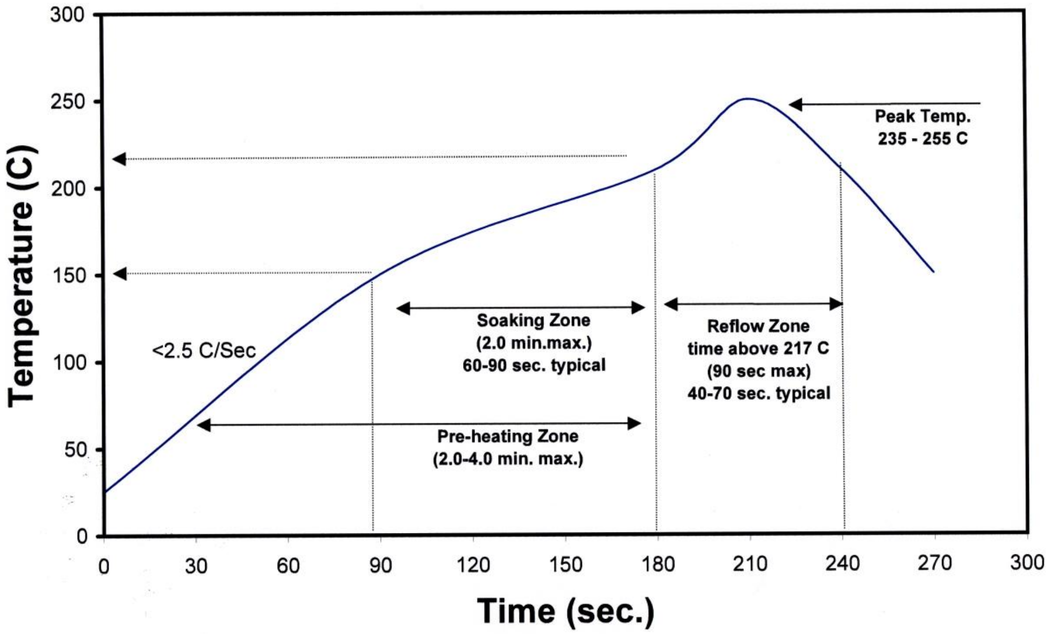

Figure 3: Reflow soldering profile for lead free soldering.

Typical Radiation Pattern

TBD

Figure 4: Typical representative spatial radiation pattern.

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Typical Relative Spectral Power Distribution

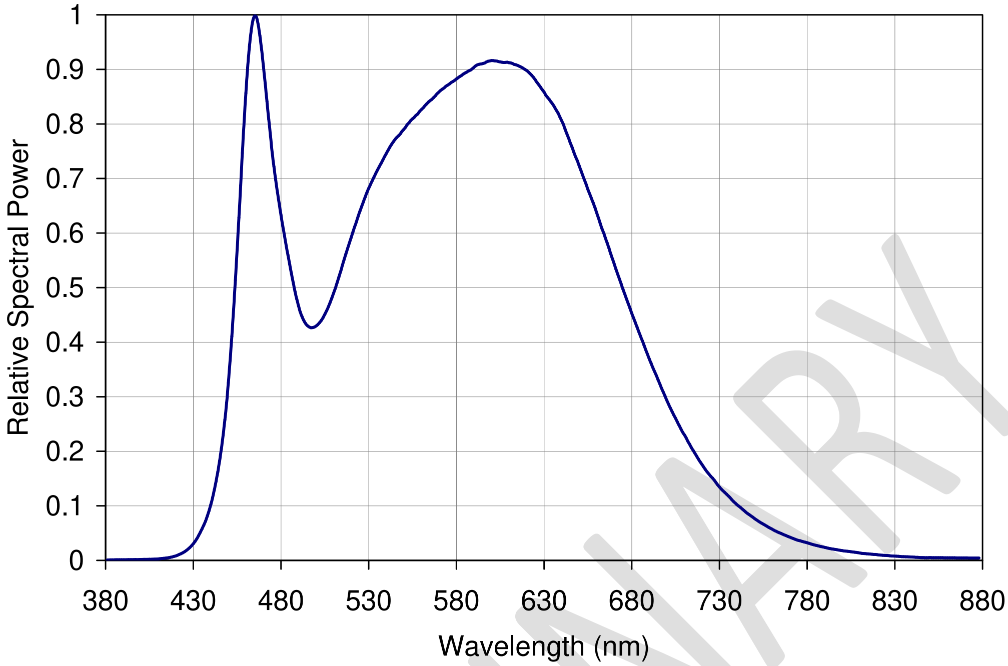

Figure 5: Relative spectral power vs. wavelength @ T_C = 25°C.

Typical Relative Light Output

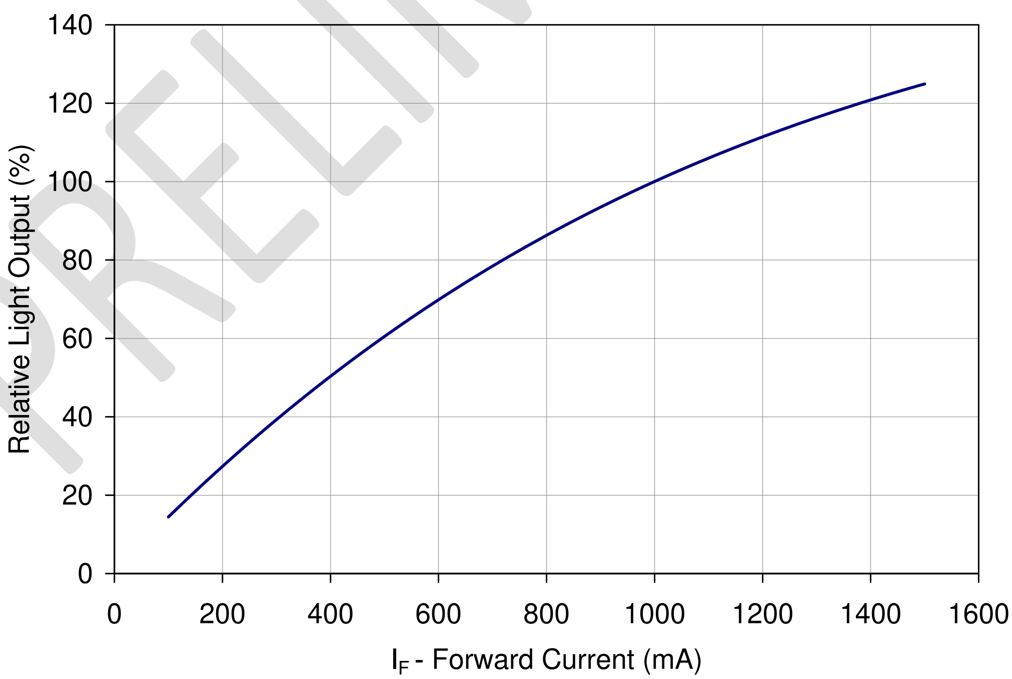

Figure 6: Typical relative light output vs. forward current @ T_C = 25°C.

Typical Relative Light Output over Temperature

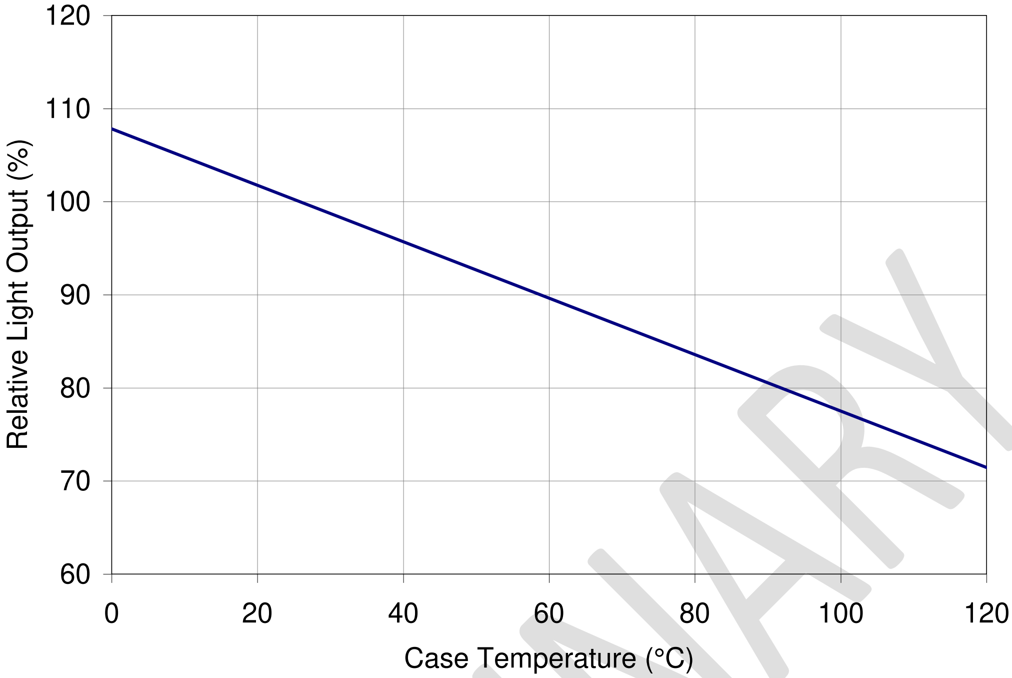

Figure 7: Typical relative light output vs. case temperature.

Typical Forward Current Characteristics

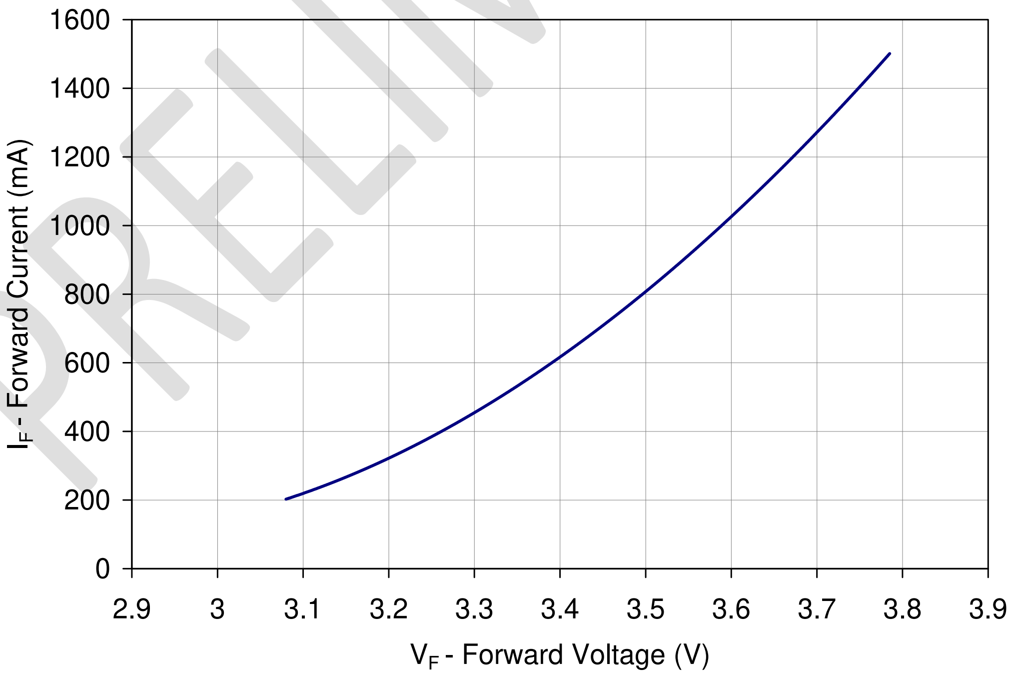

Figure 8: Typical forward current vs. forward voltage @ T_C = 25°C.

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Current De-rating

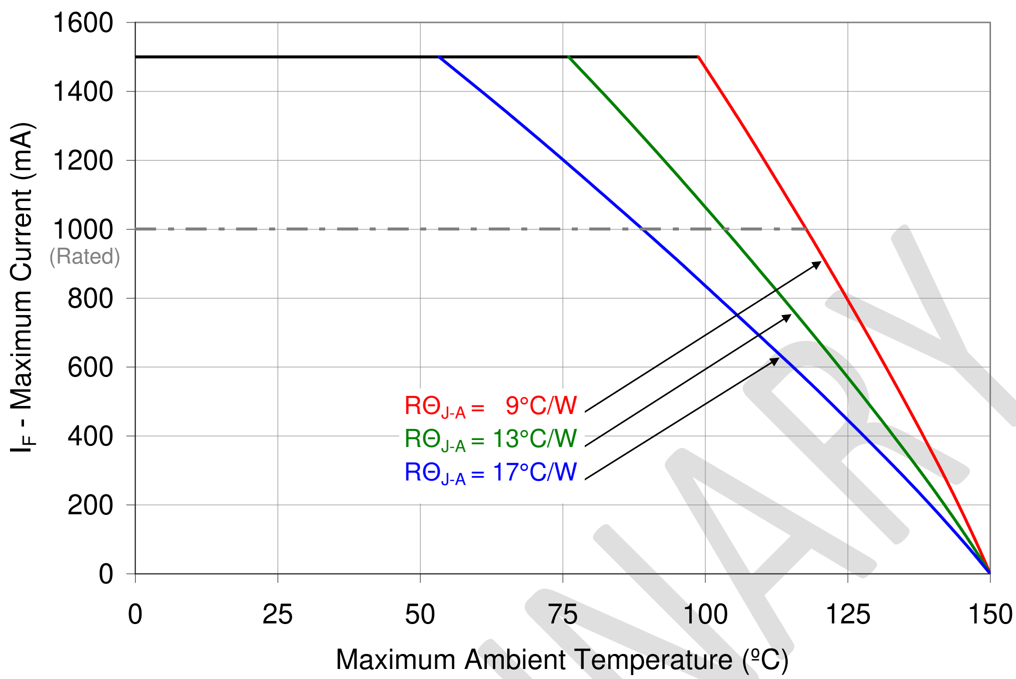

Figure 9: Maximum forward current vs. ambient temperature based on $T_{J(MAX)}$ = 150°C.

Notes for Figure 9:

1. $R\Theta_{J-C}$ [Junction to Case Thermal Resistance] for the LZ1-00NW02 is typically 6.0°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].

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Emitter Tape and Reel Specifications (mm)

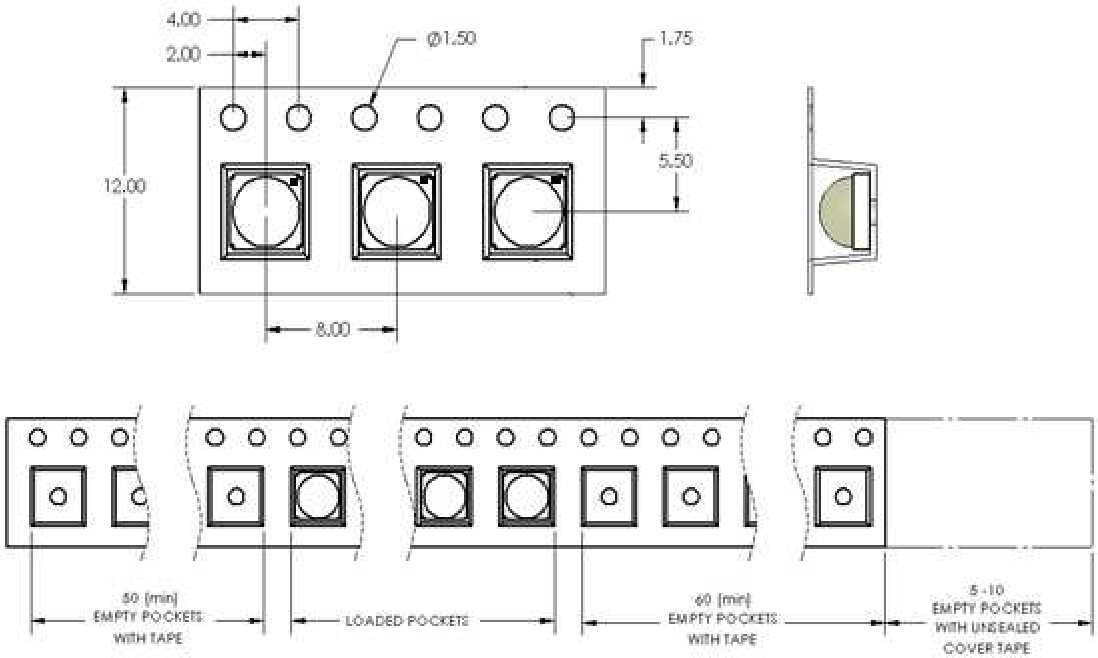

Figure 10: Emitter carrier tape specifications (mm).

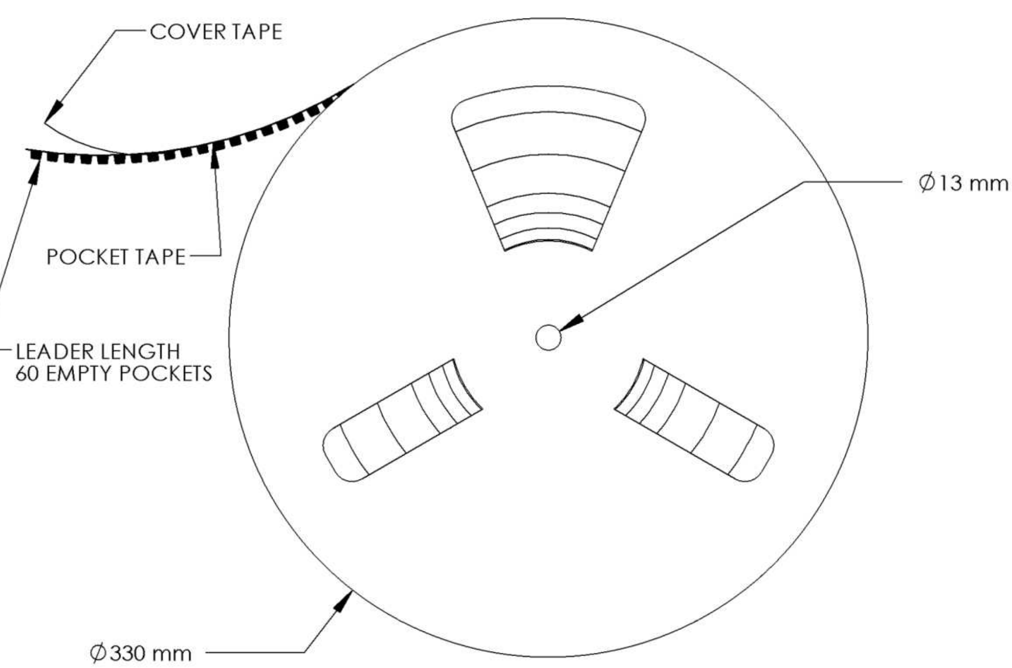

Figure 11: Emitter reel specifications (mm).

Notes for Figure 11:

1. Reel quantity minimum: 200 emitters. Reel quantity maximum: 2500 emitters.

LZ1 MCPCB Family

Part number	Type of MCPCB	Diameter (mm)	Emitter + MCPCB Thermal Resistance ($^oC/W$)	Typical V_F (V)	Typical I_F (mA)
LZ1-1xxxxx	1-channel Star	19.9	6.0 + 1.5 = 7.5	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^{o}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)

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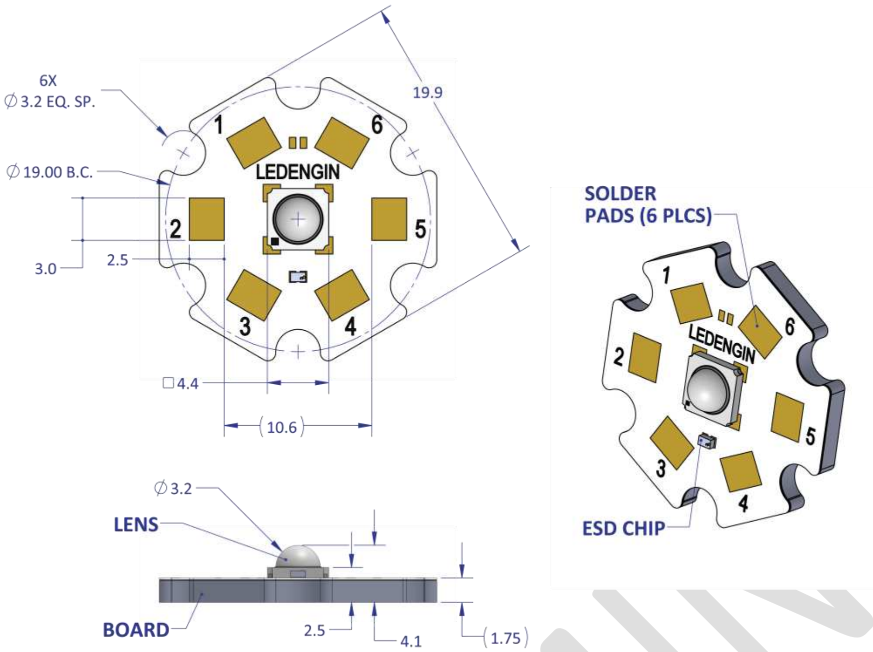
LZ1-1xxxxx

1 channel, Standard Star MCPCB (1x1) 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 heat sink.
- The thermal resistance of the MCPCB is: $R\Theta_{C-B}$ 1.5°C/W

Components used

MCPCB:	HT04503	(Bergquist)
ESD chips:	BZT52C5V1LP-7	(Diodes, Inc., for 1 LED die)

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

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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 or (408) 922-7200 for more information.

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