High Luminous Efficacy
Amber LED Emitter

# LZ1-00A100

## Key Features

- High Luminous Efficacy Amber LED
- Ultra-small foot print – 4.4mm x 4.4mm
- Surface mount ceramic package with integrated glass lens
- Very high Luminous Flux density
- New industry standard for Lumen Maintenance
- Autoclave compliant (JEDEC JESD22-A102-C)
- JEDEC Level 1 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

- Emergency vehicle lighting
- Strobe and warning lights
- Marine and buoy lighting
- Aviation and obstruction lighting
- Roadway beacons and traffic signaling
- Architectural lighting
- Stage and studio lighting
- Landscape lighting
- Automotive signal and marker lights

## Description

The LZ1-00A100 Amber LED emitter provides 5W power in an extremely small package. With a 4.4mm x 4.4mm ultra-small footprint, this package provides exceptional luminous flux density. The patent-pending 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 |
|---|---|
| LZ1-00A100-xxxx | LZ1 emitter |
| LZ1-10A100-xxxx | LZ1 emitter on Standard Star MCPCB |
| LZ1-30A100-xxxx | LZ1 emitter on Miniature round MCPCB |

### Bin kit option codes

| A1, Amber (590nm) | | | |
|---|---|---|---|
| **Kit number suffix** | **Min flux Bin** | **Color Bin Range** | **Description** |
| 0000 | K | A3 – A6 | full distribution flux; full distribution wavelength |

Notes:

1. Default bin kit option is -0000




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## Luminous Flux Bins

Table 1:

| Bin Code | Minimum Luminous Flux ($\Phi_V$) @ $I_F$ = 1000mA [1,2] (lm) | Maximum Luminous Flux ($\Phi_V$) @ $I_F$ = 1000mA [1,2] (lm) |
|---|---|---|
| K | 75 | 93 |
| L | 93 | 117 |
| M | 117 | 146 |

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.

## Dominant Wavelength Bins

Table 2:

| Bin Code | Minimum Dominant Wavelength ($\lambda_D$) @ $I_F$ = 1000mA [1] (nm) | Maximum Dominant Wavelength ($\lambda_D$) @ $I_F$ = 1000mA [1] (nm) |
|---|---|---|
| A3 | 587.5 | 590.0 |
| A4 | 590.0 | 592.5 |
| A5 | 592.5 | 595.0 |
| A6 | 595.0 | 597.5 |

Notes for Table 2:
1. Dominant wavelength is derived from the CIE 1931 Chromaticity Diagram and represents the perceived hue.
2. LED Engin maintains a tolerance of ± 1.0nm on dominant wavelength measurements.

## Forward Voltage Bins

Table 3:

| Bin Code | Minimum Forward Voltage ($V_F$) @ $I_F$ = 1000mA [1] (V) | Maximum Forward Voltage ($V_F$) @ $I_F$ = 1000mA [1] (V) |
|---|---|---|
| 0 | 2.24 | 2.9 |

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




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## Absolute Maximum Ratings

Table 4:

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| DC Forward Current at $T_{jmax}$=100°C [1] | $I_F$ | 1200 | mA |
| DC Forward Current at $T_{jmax}$=125°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 ~ +125 | °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,<br>100% RH for 168 hours | |
| ESD Sensitivity [6] | | > 8,000 V HBM<br>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 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 020D. See Reflow Soldering Profile Figure 3.
5. Autoclave Conditions per JEDEC JESD22-A102-C.
6. LED Engin recommends taking reasonable precautions towards possible ESD damages and handling the LZ1-00A100 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 |
|---|---|---|---|
| Luminous Flux (@ $I_F$ = 1000mA) | $\Phi_V$ | 105 | lm |
| Dominant Wavelength (@ $I_F$ = 1000mA) [1] | $\lambda_D$ | 590 | nm |
| Viewing Angle [2] | $2\Theta_{1/2}$ | 76 | Degrees |
| Total Included Angle [3] | $\Theta_{0.9V}$ | 115 | Degrees |

Notes for Table 5:
1. Amber LEDs have a significant shift in wavelength over temperature; please refer to Figure 6 for details. Caution must be exercised if designing to meet a regulated color space due to this behavior as product may shift out of legal color space under elevated temperatures.
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 |
|---|---|---|---|
| Forward Voltage (@ $I_F$ = 1000mA) | $V_F$ | 2.6 | V |
| Forward Voltage (@ $I_F$ = 1200mA) | $V_F$ | 2.7 | V |
| Temperature Coefficient of Forward Voltage | $\Delta V_F/\Delta T_J$ | -1.9 | mV/°C |
| Thermal Resistance (Junction to Case) | $R\Theta_{J-C}$ | 10 | °C/W |




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## 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 1000 mA. This projection is based on constant current operation with junction temperature maintained at or below 110°C.




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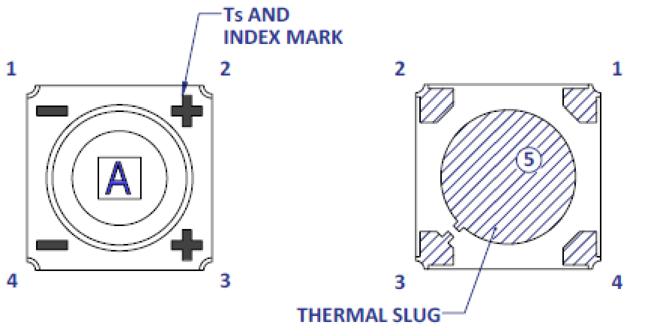
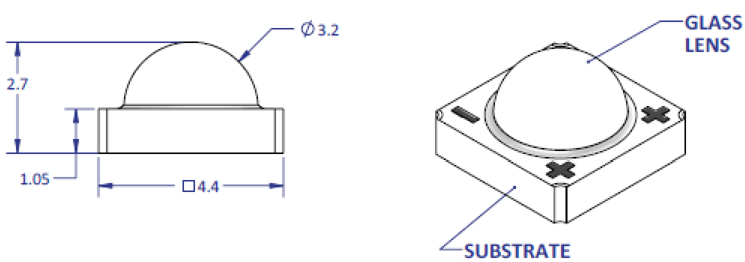
# Mechanical Dimensions (mm)




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



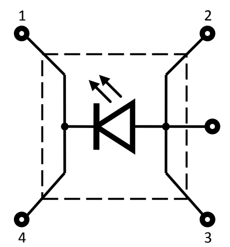




Figure 1: Package outline drawing.

Notes for Figure 1:

1. Unless otherwise noted, the tolerance = ± 0.20 mm.
2. Thermal contact, Pad 5, is electrically connected to the Anode, Pads 2 and 3. Do not electrically connect any electrical pads to the thermal contact, Pad 5. LED Engin recommends mounting the LZ1-00A100 to a MCPCB that provides insulation between all electrical pads and the thermal contact, Pad 5. LED Engin offers LZ1-10A100 and LZ1-30A100 MCPCB options which provide both electrical and thermal contact insulation with low thermal resistance. Please refer to Application Note MCPCB Options 1 and 3, or contact a LED Engin sales representative for more information.

# Recommended Solder Pad Layout (mm)

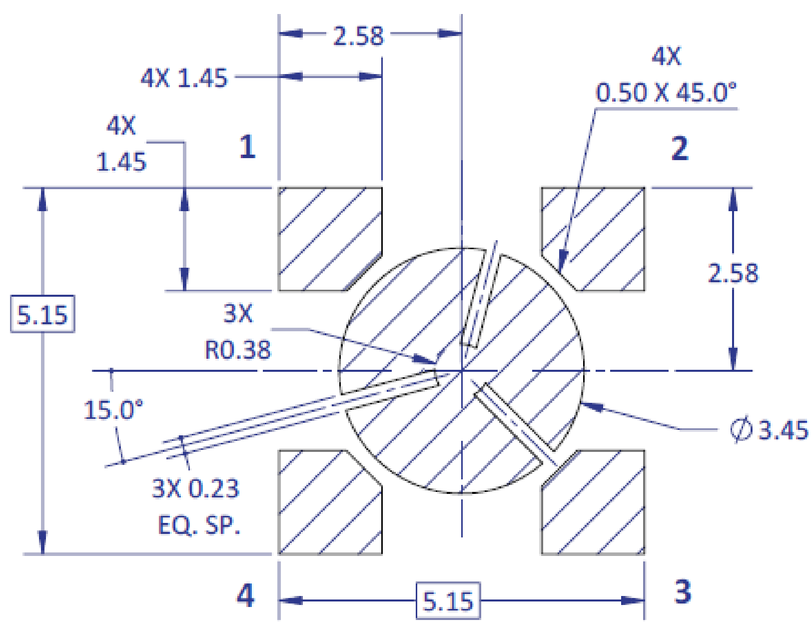



Figure 2a: Recommended solder pad layout for anode, cathode, and thermal pad

Note for Figure 2a:

1. Unless otherwise noted, the tolerance = ± 0.20 mm.

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## Recommended Solder Mask Layout (mm)

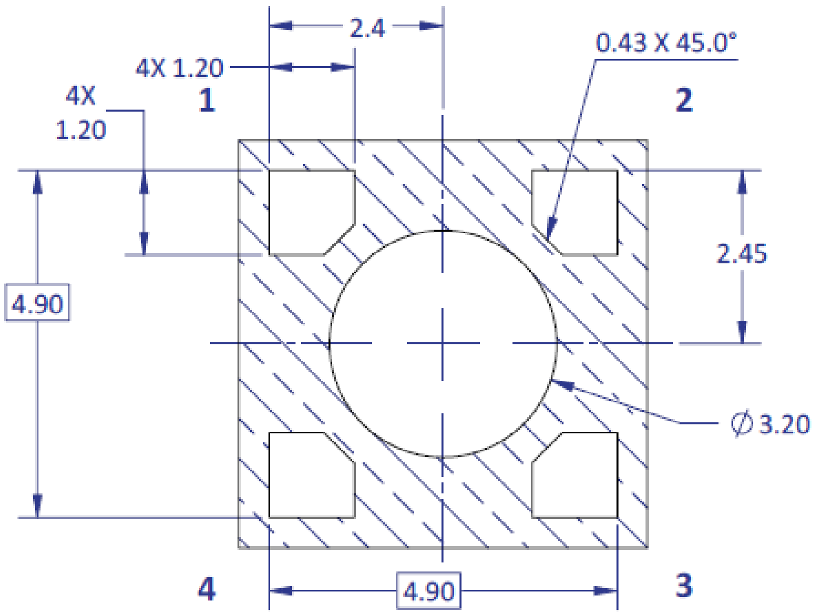


Figure 2b: Recommended solder mask opening for anode, cathode, and thermal pad

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

## Recommended 8mil Stencil Apertures Layout (mm)

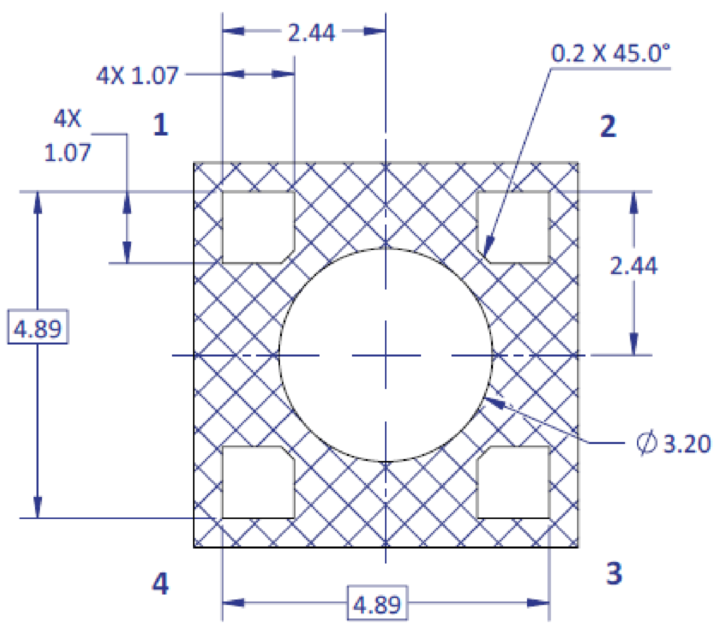


Figure 2c: Recommended 8mil stencil apertures layout for anode, cathode, and thermal pad

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




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## Reflow Soldering Profile

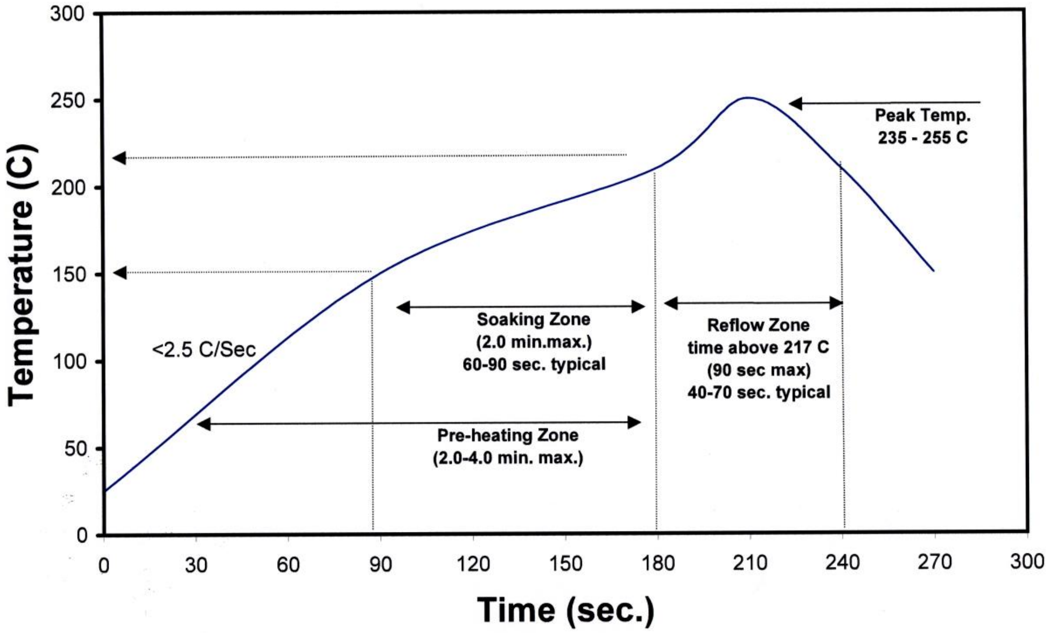


Figure 3: Reflow soldering profile for lead free soldering.

## Typical Radiation Pattern

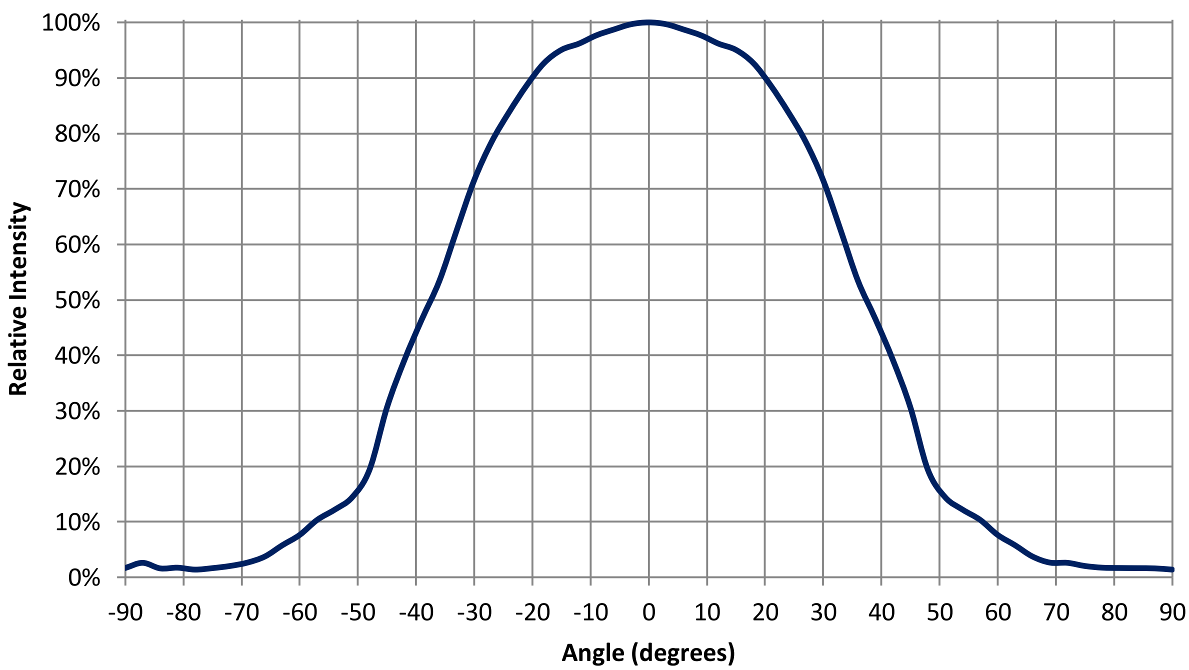


Figure 4: Typical representative spatial radiation pattern.




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## Typical Relative Spectral Power Distribution

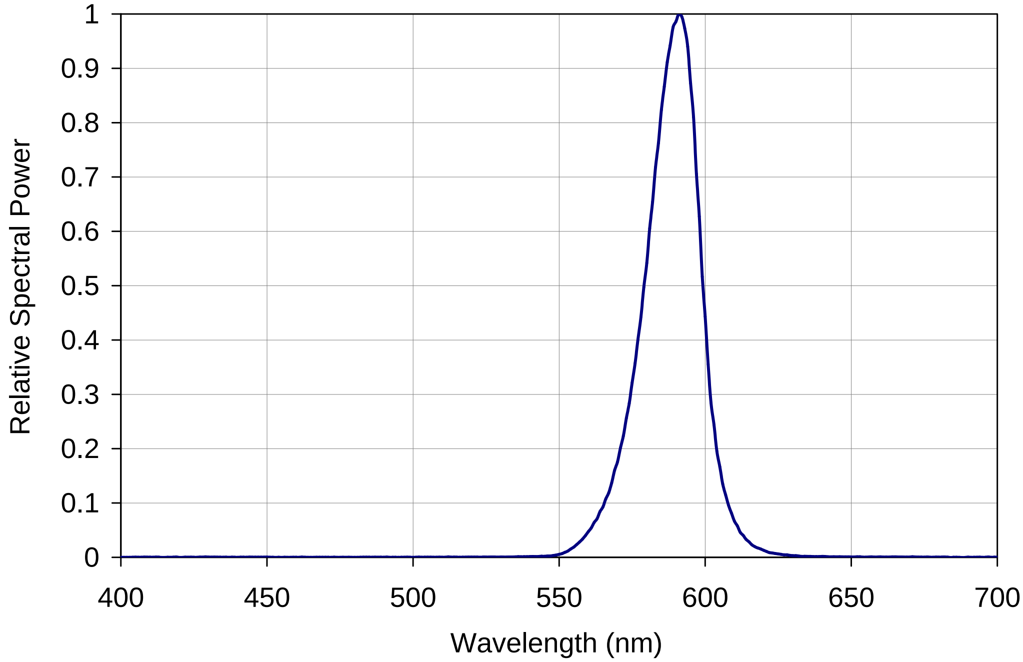


Figure 5: Relative spectral power vs. wavelength @ $T_C$ = 25°C.

## Typical Relative Dominant Wavelength Shift over Temperature

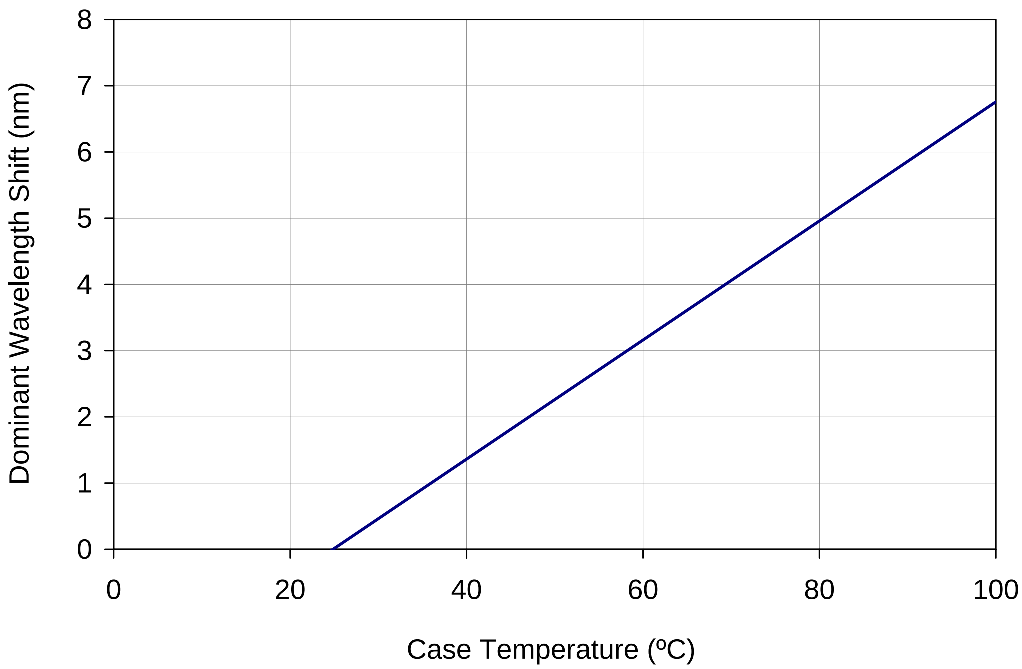


Figure 6: Typical dominant wavelength shift vs. case temperature.





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## Typical Relative Light Output

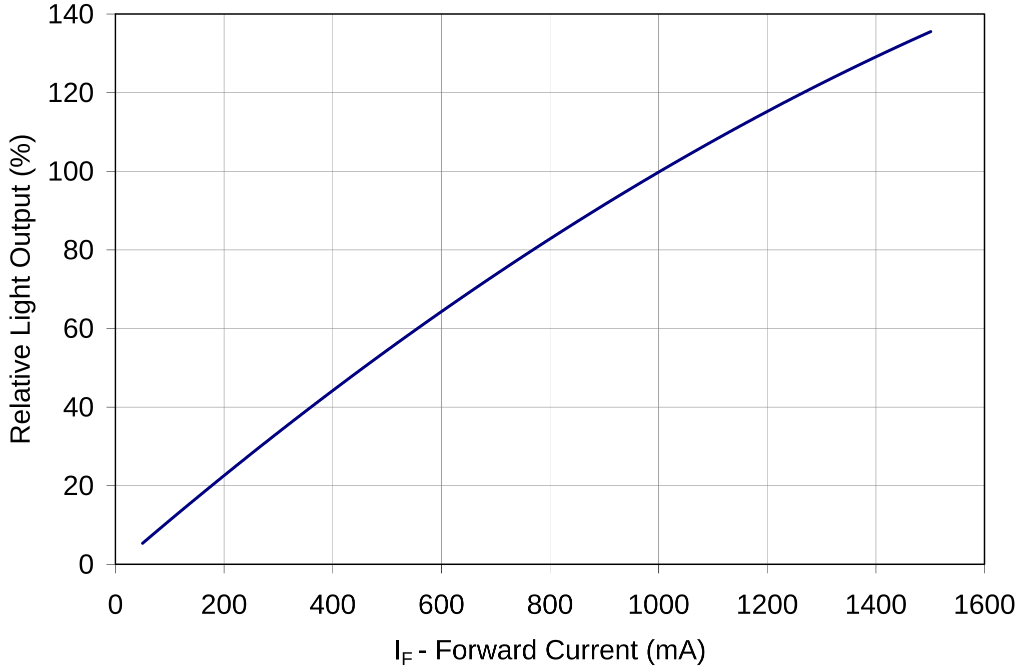


Figure 7: Typical relative light output vs. forward current @ $T_C$ = 25°C.

## Typical Relative Light Output over Temperature

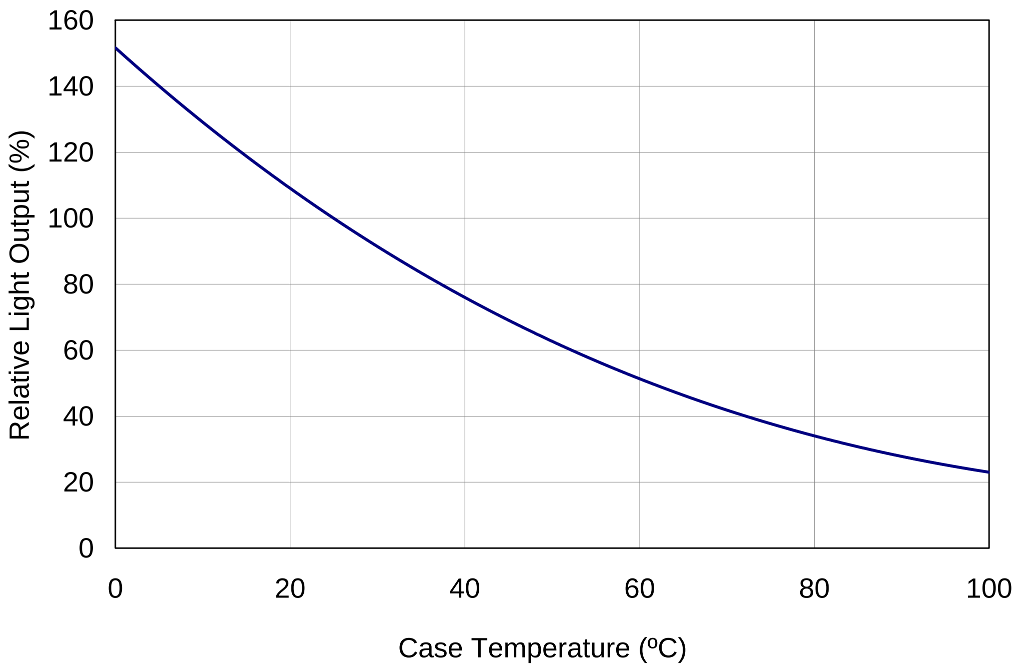


Figure 8: Typical relative light output vs. case temperature.




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## Typical Forward Current Characteristics

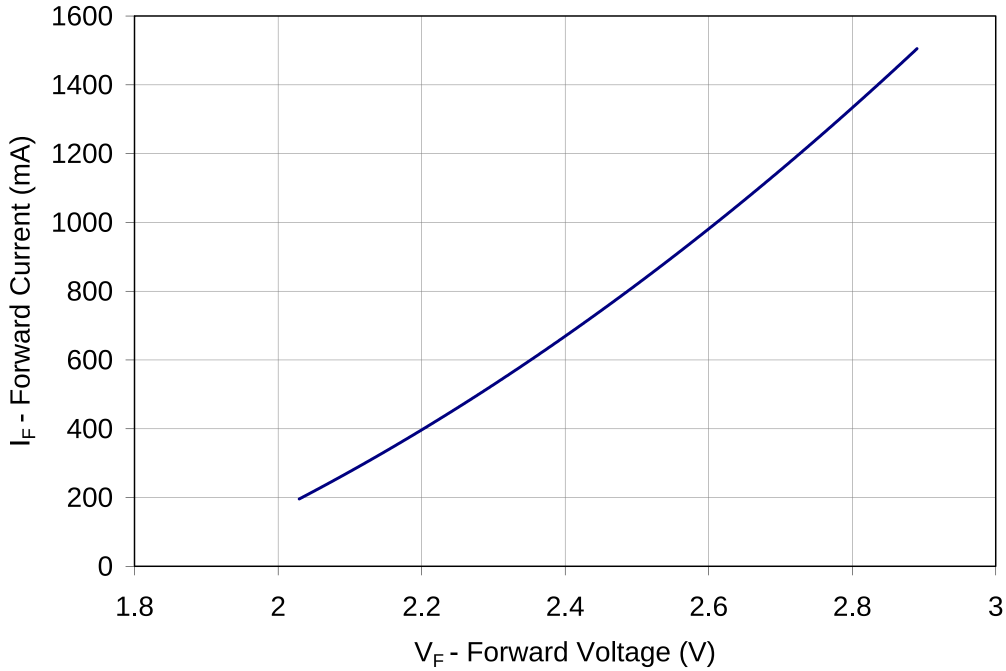


Figure 9: Typical forward current vs. forward voltage @ $T_C$ = 25°C.

## Current De-rating

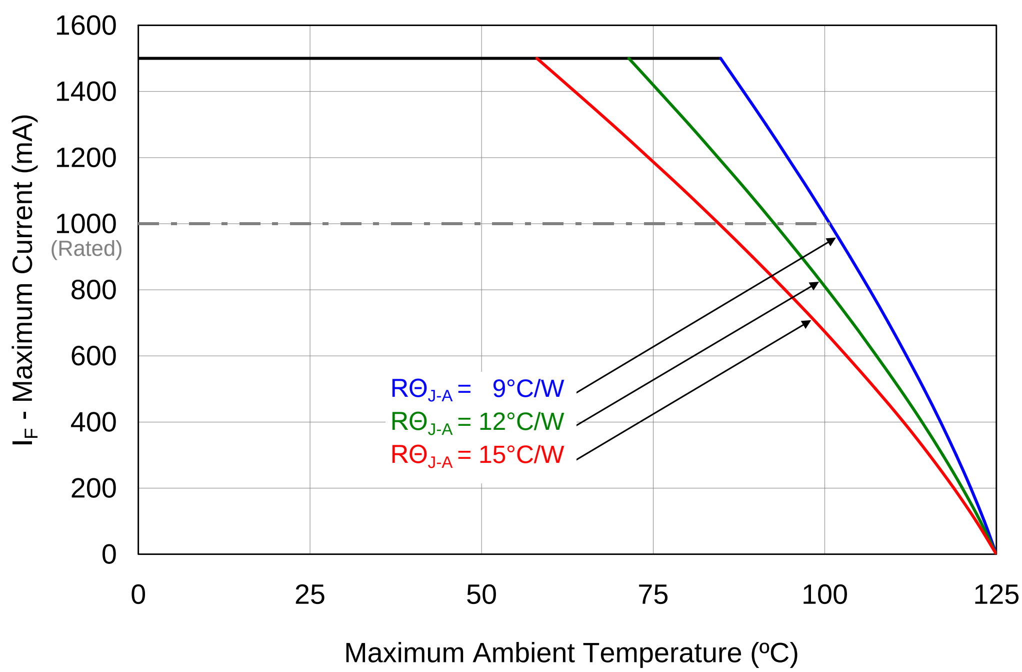


Figure 10: Maximum forward current vs. ambient temperature based on $T_{J(MAX)}$ = 125°C.

Notes for Figure 10:

1. $R\Theta_{J-C}$ [Junction to Case Thermal Resistance] for the LZ1-00A100 is typically 10°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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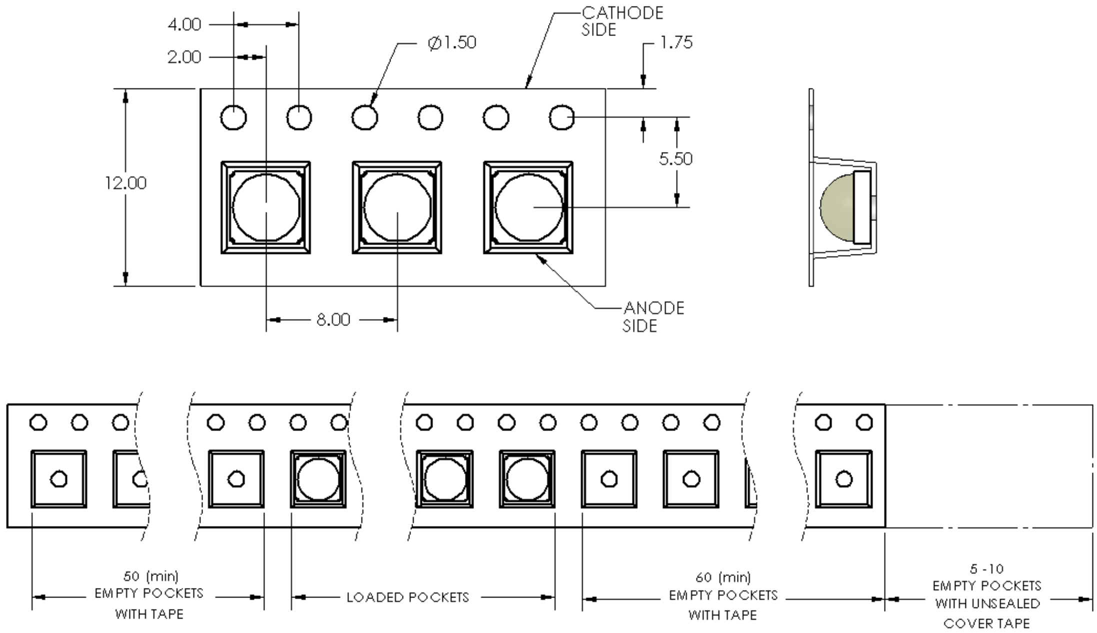
Emitter Tape and Reel Specifications (mm)



Figure 11: Emitter carrier tape specifications (mm).

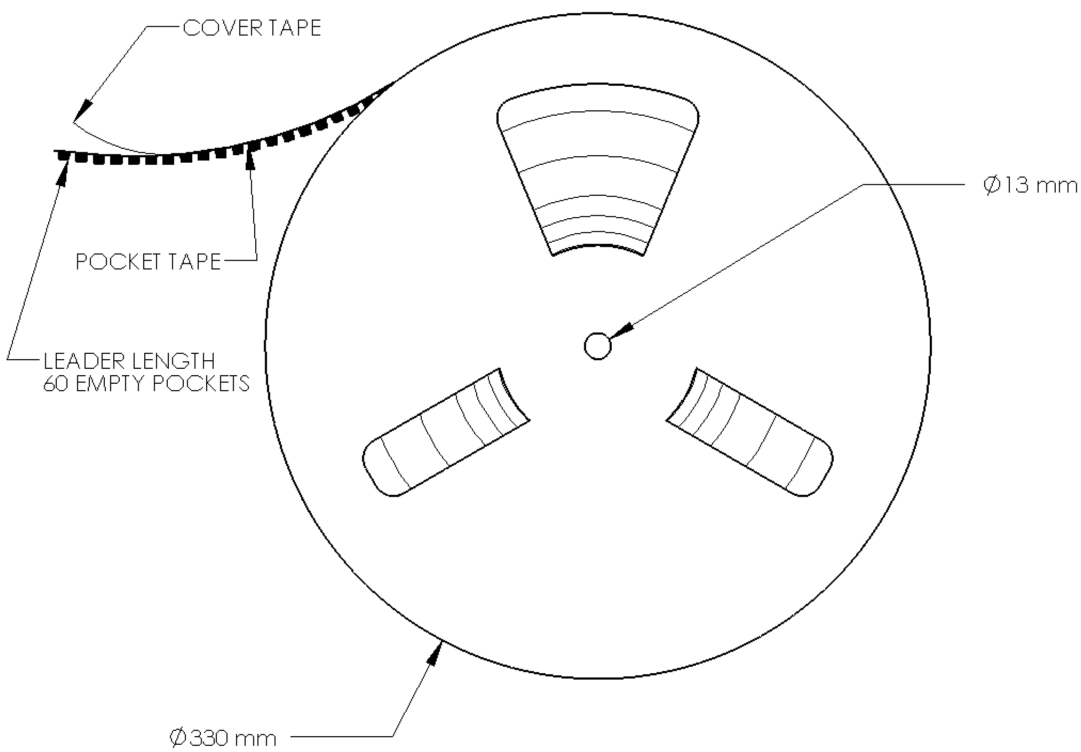



Figure 12: Emitter reel specifications (mm).

Notes for Figure 12:

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

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# 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 | 10.5 + 1.5 = 12.0 | 2.6 | 1000 |
| **LZ1-3xxxxx** | 1-channel Mini | 11.5 | 10.5 + 2.0 = 12.5 | 2.6 | 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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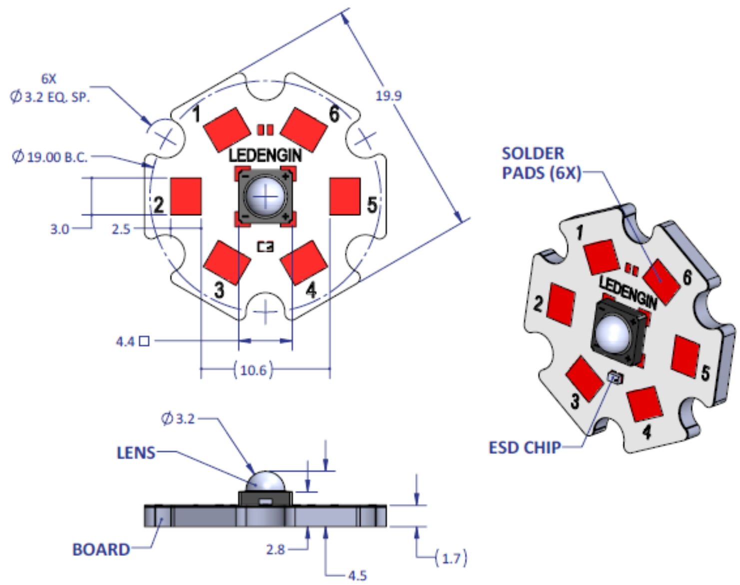
# LZ1-1xxxxx

## 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.
- Electrical connection pads on MCPCB are labeled "+" for Anode and "-" for Cathode.
- LED Engin recommends using thermal interface material when attaching the MCPCB to a heat sink.
- The thermal resistance of the MCPCB is: RΘC-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 + |



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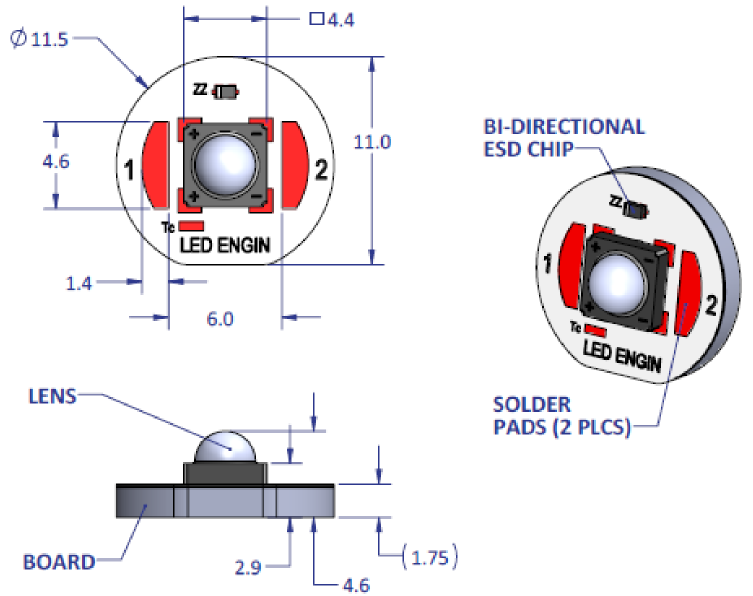
# LZ1-3xxxxx

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




Notes:

- Unless otherwise noted, the tolerance = ± 0.20 mm.
- Electrical connection pads on MCPCB are labeled "+" for Anode and "-" for Cathode.
- LED Engin recommends using thermal interface material when attaching the MCPCB to a heat sink.
- The thermal resistance of the MCPCB is: RΘC-B 2.0°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 - |

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## Company Information

LED Engin, Inc., based in California's Silicon Valley, specializes in ultra-bright, ultra compact solid state lighting solutions allowing lighting designers & engineers the freedom to create uncompromised yet energy efficient lighting experiences. The LuxiGen™ Platform — an emitter and lens combination or integrated module solution, delivers superior flexibility in light output, ranging from 3W to 90W, a wide spectrum of available colors, including whites, multi-color and UV, and the ability to deliver upwards of 5,000 high quality lumens to a target. The small size combined with powerful output allows for a previously unobtainable freedom of design wherever high-flux density, directional light is required. LED Engin's packaging technologies lead the industry with products that feature lowest thermal resistance, highest flux density and consummate reliability, enabling compact and efficient solid state lighting solutions.

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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