

# EZBright™ LED Handling and Packaging Recommendations

This applications note provides the user with a basic understanding of Cree’s EZBright LED chips, as well as recommendations on handling and packaging.

Cree’s EZBright LEDs are the next generation of solid-state LED emitters that combine highly efficient InGaN materials with Cree’s proprietary optical design and device structure technology to deliver superior value for high-intensity LEDs. The optical design maximizes light extraction efficiency and enables a Lambertian radiation pattern. These LEDs are attachable either with conductive adhesive or solder.

EZBright termination metal designs vary by part type:

- EZ290™ and EZR260™ LEDs are available with a Au termination
- EZ1000™ LEDs are available with an 80:20 AuSn termination

## EZBright LED Structure

### EZ290 LED

A cross-sectional diagram of the EZ290 LED is shown in Figure 1 with nominal dimensions. The EZ290 LED has a vertical structure with a topside 90- $\mu\text{m}$  circular bondpad cathode (-) terminal and a gold-terminated anode (+) on the bottom of the silicon substrate. The LED emitting layer is metallically bonded to the silicon substrate, and the periphery of the emitting mesa is passivated. For more detailed dimensional information and operational characteristics, please consult the EZ290 LED specification document, CPR3CQ, at the Cree website: [www.cree.com/products/led\\_docs.asp](http://www.cree.com/products/led_docs.asp).

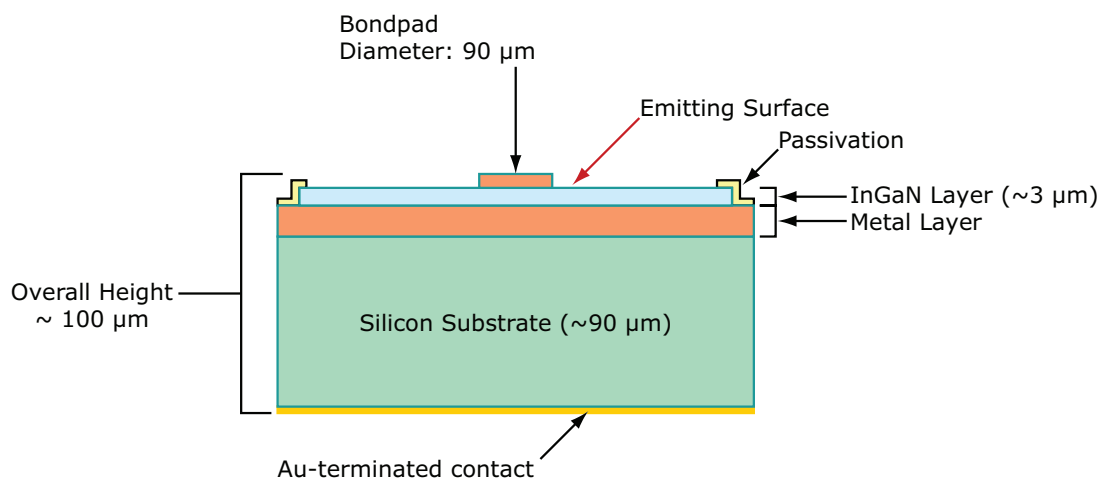


Figure 1: EZ290 LED schematic cross-sectional view [dimensions are nominal]

**EZR260 LED**

A cross-sectional diagram of the EZR260 LED is shown in Figure 2 with nominal dimensions. The EZR260 LED has a vertical structure with a topside 100 μm wide x 100 μm semicircular bondpad cathode (-) terminal and a gold-terminated anode (+) on the bottom of the silicon substrate. The LED emitting layer is metallurgically bonded to the silicon substrate, and the periphery of the emitting mesa is passivated. For more detailed dimensional information and operational characteristics, please consult the EZR260 LED specification document, CPR3CG, at the Cree website: [www.cree.com/products/led\\_docs.asp](http://www.cree.com/products/led_docs.asp).

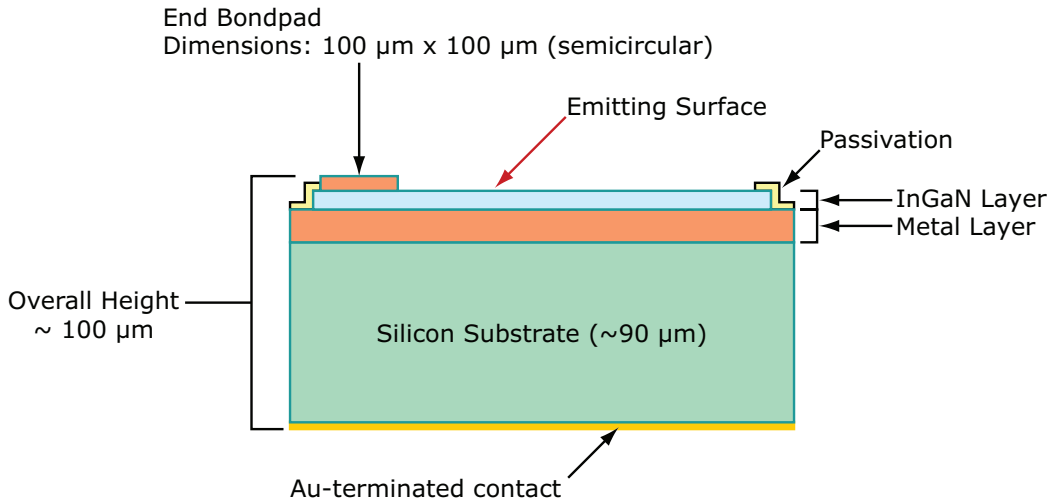


Figure 2: EZR260 LED schematic cross-sectional view [dimensions are nominal]

**EZ1000 LED**

A cross-sectional diagram of the EZ1000 LED is shown in Figure 3 with nominal dimensions. The EZ1000 LED has a vertical structure with two topside 130 μm wide x 130 μm square bondpad cathode (-) terminals and an 80:20 AuSn-terminated anode (+) on the bottom of the silicon substrate. The LED emitting layer is metallurgically bonded to the silicon substrate, and the periphery of the emitting mesa is passivated. For more detailed dimensional information and operational characteristics, please consult the EZ1000 LED specification document, CPR3CR, at the Cree website: [www.cree.com/products/led\\_docs.asp](http://www.cree.com/products/led_docs.asp).

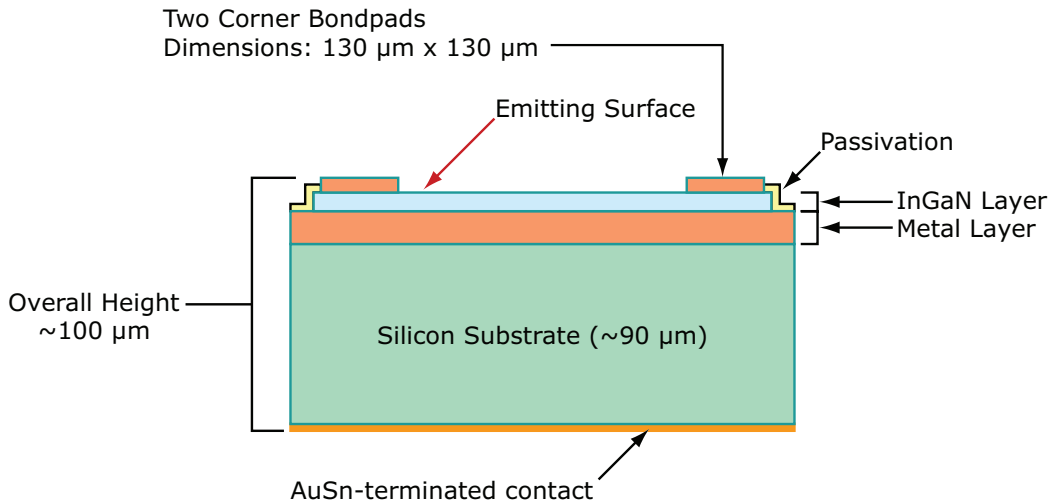


Figure 3: EZ1000 LED schematic cross-sectional view [dimensions are nominal]

## EZBright LED Chip Handling

In general, industry-standard handling procedures can be used with the EZBright LED chip. EZBright LED chips are shipped wire bond pad up, not requiring die transfer prior to die attach. Both coaxial and radial lighting sources (ring or fiber lights) are recommended for pattern-recognition systems in automated pick-and-place or bonding processes. Low-angle side lighting may also be used to provide improved contrast.

Several handling guidelines must be followed to maintain optimal performance:

- Minimize contact between metallic fixtures, equipment, tweezers, or other hard objects and the emitting surface or the edge of the junction mesa, as excessive contact force can damage the junction, leading to increased device leakage and reduced optical output.
- If possible, avoid application of tapes or adhesives to the emitting surface. Tape residue can contaminate the textured surface, leading to reduced light extraction efficiency or poor lamp encapsulant adhesion.
- Rubber collets and handling fixtures with hardness in the approximate range of 80 (Shore A), or equivalent, are recommended. Harder plastic collets may also be used, in which case minimization of die placement or bonding parameters (forces) is recommended. The selection of bonding force level should be confirmed through reliability testing. See Table 1 for more information on collet selection.
- Although the use of metal collets is not recommended for processing EZBright LEDs, it may be necessary in situations where no alternative collet materials are available. The selection of bonding parameters should be confirmed through reliability testing.
- It is recommended that ejector pins contacting the backside surface of EZ1000 LEDs during the die pick process have a minimum tip radius of 50 μm in order to prevent chip damage.

### Collets

A wide variety of rubber and plastic collets are available for use with EZBright LEDs. A selection of collets, sized for

use with EZ1000 LED and the smaller EZ290 and EZR260 LED chips, are shown in Table 1. Different collet materials, including Teflon, Vespel, silicone rubber, Viton, etc., are compatible with different temperature ranges. Supplier information is provided following Table 1; customers should contact the collet manufacturer for recommendations on designs specific to their applications and die bonding equipment. Additional suppliers and designs are available; please contact Cree ([www.cree.com](http://www.cree.com)) for more information.

Some dimensional-critical applications, such as die bonding in narrow-walled side-view SMT packages, will require specialty collets. In this case, a rectangular tipped collet may provide superior performance. One collet design proven successful for this application using EZR260 is the SPT 2102D5-18-HTV-RT -0.23-0.40-0.13. This is a Vespel (high-temperature plastic) collet with rectangular tip geometry. Please contact the collet manufacturer for collet designs compatible with specific package geometries.

Chip Size (µm)	Temperature	Supplier	Material	OD (mm)	ID (mm)	Part #
EZ1000	Low	SPT	Thermoplastic Elastomer	0.76-1.02	0.40-0.50	PCTR-A-series
	Mid	Micro Mechanics	High Temp Rubber	0.75-1.00	0.40-0.50	HTR1A-series
		Micro Mechanics	High Temp Rubber	0.75-1.00	0.40-0.50	HTR3-series
		SPT	High Temp Rubber	0.76-1.02	0.4	HCTR-series
	High	SPT	Vespel	0.76-1.00	0.38-0.50	2151-HTV21-CT-series
		Micro Mechanics	High Temp Plastic	0.75-1.00	0.40-0.50	11-072-series
Shukwang Mechatric Co.		High Temp Rubber	1	0.4	SKHC-F series	
EZ290, EZR260	Low	Micro Mechanics	Rubber	0.25-0.38	0.15	13-124-series
	High	SPT	Vespel	0.25-0.38	0.15	2151-HTV-CT-series
		Micro Mechanics	High Temp Plastic	0.23-0.25	0.13-0.15	PT1-23-series

Table 1: Selected collets identified for evaluation with EZBright LED

## Supplier Information

Micro Mechanics  
 (www.micro-mechanics.com)  
 Singapore, China, Taiwan, Japan

Small Precision Tools (SPT)  
 (www.smallprecisiontools.com)  
 USA, Singapore, China, Japan

Shukwang Mechatric Co., Ltd.  
 2nd Floor, Buri B/D, 71-15, Oguem-Dong, Songpa Gu, 138-857, Seoul, Korea  
 Ph: 82-2-4076832

## EZBright LED Die Attach

All EZBright LED chips can be attached using electrically conductive adhesive (e.g. Ag epoxy). The EZ290 LED chip is specifically designed for Ag-epoxy die attach, with a target bond depth of 35 µm and a maximum depth of 50 µm. It is important that the epoxy completely underfill the EZBright LED chip, as this will ensure adequate die adhesion and will provide a rigid support to the chip during subsequent wirebonding.

EZBright LED chips can also be attached using solder. EZ290 LED and EZR260 LED chips are supplied with Au terminations and, therefore, require solder paste or solder preforms to achieve a solder joint. EZ1000 LEDs are supplied with an 80:20 AuSn termination, which enables die attach using a flux eutectic reflow process, in addition to die attach using Ag epoxy or alternate solders. For all solder attach processes, the following guidelines must be observed:

- The maximum reflow process conditions for EZ290 LED and EZR260 LED chips are 270°C for 10 seconds. This process window is adequate for the reflow of a range of solders, including Pb-free solders. It is recommended that temperature profiles be verified by **direct measurement** at the LED chip to ensure that the maximum process limits are not exceeded.
- The maximum reflow process conditions for EZ1000 LEDs are 325°C for 5 seconds. This process window is adequate for the reflow of 80:20 AuSn and a range of other solders, including Pb-free solders. It is recommended that temperature profiles be verified by **direct measurement** at the LED chip to ensure that the maximum process limits are not exceeded.
- Only no-clean fluxes should be used, either in the solder paste or in the flux-eutectic reflow process. Cree suggests the following flux brands:
  - ◇ Alpha Metals UP78 (or UP78-PT equivalent) (U.S.)
  - ◇ Arakawa WHP-002 (Japan/Asia)
  - ◇ Indium TACFlux 007 (U.S./Japan/Asia)Alternative fluxes should be evaluated by the customer, as appropriate.
- Flux residue should be cleaned in isopropyl alcohol in an ultrasonic bath for 15 minutes prior to wirebonding and encapsulation. Alternate liquid cleaning processes may be suitable but must be thoroughly evaluated for compatibility with the EZBright LED chip.
- If plasma cleaning is a customer consideration, Cree recommends that the devices not be exposed to hydrogen plasmas. Addition of hydrogen to other types of plasma should be minimized.
- Minimal pressure should be applied to the EZBright chip during the soldering process. Pressure eutectic attach of EZ1000 LEDs is not a Cree-recommended process; however, if the customer elects to use this process, then a maximum bonding force of **50 grams** is recommended.
- Complete solder underfill of the EZBright chip is required to provide a rigid support to the chip for subsequent wirebonding.

Additional information about flux eutectic die attach of Cree LED chips can be found in Applications Guide CPR3-AN03; all of the handling and process guidelines described in this document must be observed for die attach of EZBright LEDs.

## EZBright LED Wire Bonding

EZBright LED chips are designed for Au-ball wirebonding. It is important that the entire ball bond remain within the confines of the bondpad area and that no metal contact the emitting surface. Care must also be taken to prevent the wire capillary fixture from contacting the emitting surface as this can damage the LED junction.

Customers experienced with Cree’s SiC-based chips may have developed wirebonding parameters suitable to the very rigid and hard characteristics of the SiC substrate. These existing parameters may need to be re-evaluated for the EZBright LED, which is constructed on a lower-rigidity silicon substrate. If the customer suspects that the wirebonding process is damaging the EZBright chip, then the following should be considered:

- Wirebonding force and ultrasonic power should be minimized
- Capillary geometry should be changed to minimize the force required for ball formation
- Wirebonding process temperatures may be increased to reduce the required bonding forces/powers
- Use softer Au wire

Absolute bonding parameters for EZBright LED chips cannot be specified since bonding equipment and materials vary greatly. Table 2 lists target parameters that may be used as a guideline for wirebond development. Customer are advised to optimize bonding parameters on their specific equipment.

Wirebonding Parameter*	Target Value
Contact Force	50 g-force
Bond Time	9-12 ms
Bond Force	35-40 g-force
Ultrasonic Power	100 mW

\* Parameters based on settings for ASM Eagle 60 Au-ball bonder using 1.0 and 1.2 mil Au wire at 160°C bonding temperature, Gaiser 1572-17-437GM-20D capillary, 138 kHz ultrasonic frequency.

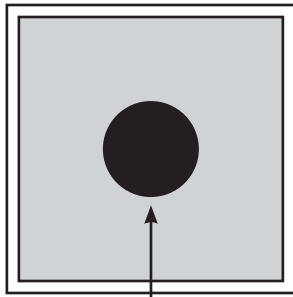
Table 2: Target wirebonding parameters

The EZ290 LED chip (Figure 4) features a centered circular Au bondpad, nominally 90 µm in diameter. A maximum wire diameter of 1 mil (25 µm) is recommended in order to remain within the 90-µm diameter bondpad region.

The EZR260 LED (Figure 5) features a Au bondpad located at the narrow end of the chip, nominally 100 µm wide and 100 µm to the apex of the semicircular geometry. A wire diameter of 1 mil (25 µm) is recommended in order to remain within the 100-µm diameter bondpad region.

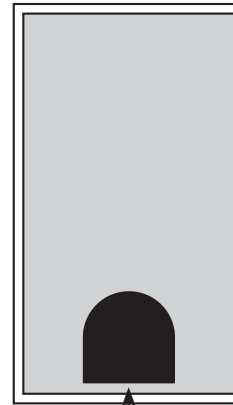
The EZ1000 LED (Figure 6) features two 130-µm square Au bondpads located in adjacent corners. This two-bondpad configuration allows the option of either single-or double-wirebonding, though double wirebonding is recommended for optimal performance. Wire diameters up to 1.25 mil (30 µm) are recommended, but caution must be observed for larger wires in maintaining the bond within the pad area.

**Important:** Both the EZ1000 Led and the EZR260 LED chips feature bondpads adjacent to the edge of the junction mesa. Care must be taken to prevent any wirebond metal from exceeding the bondpad geometry confines and lapping over the edge of the mesa as this could lead to shunting leakage and/or junction damage.



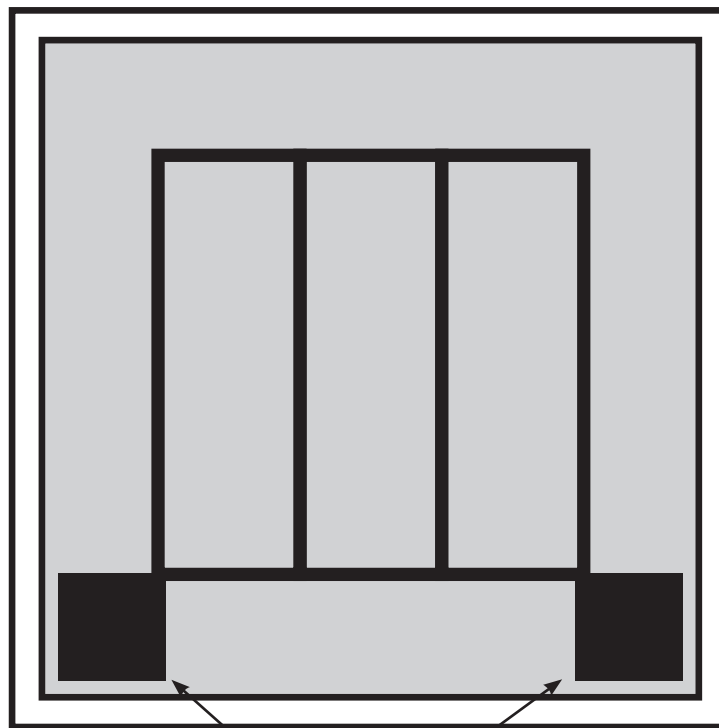
Au Bondpad  
90- $\mu\text{m}$  diameter

Figure 4: EZ290 LED



Au Bondpad  
100 x 100  $\mu\text{m}$

Figure 5: EZR260 LED



Au Bondpads  
130 x 130  $\mu\text{m}$

Figure 6: EZ1000 LED