PRODUCT Application Notes

Enhanced Vertical LED Chip

Handling and Package Notes

(Back metal Au)

Introduction

The Enhanced Vertical (EV™) LED series is the latest innovation in high brightness LED chips, an ideal light source for general lighting applications, including street lighting, commercial and residential lighting. Featuring SemiLEDs' vertical chip structure on a patented metal alloy substrate and manufactured with our proprietary process, the EV LEDs offer advantages in excellent optical output and high thermal conductivity, thereby achieving greater light quality, color consistency, reliability and overall efficiency of the luminaire. Further design advances of the EV LED structure, offer higher thermal endurance for process temperatures up to 325° Celsius and maximum suggested junction temperature of 150° Celsius.

Among pure metals at room temperature, copper has the second highest electrical and thermal conductivity after silver. Furthermore, due to the high thermal conductivity of the copper alloy layer, the heat generated in our device is effectively removed. This is a major advantage for any lamp or luminaire manufacturer when using SemiLEDs EV LED chip.

SemiLEDs' patented and unique process uses a limited quantity of Sapphire, which can be recycled and reused multiple times, significantly reducing the Carbon footprint. The reduced dependence on Sapphire also removes a thermal management bottleneck while providing the most environmentally friendly LED on the market.

SEMILEDS

PRODUCT Application Notes

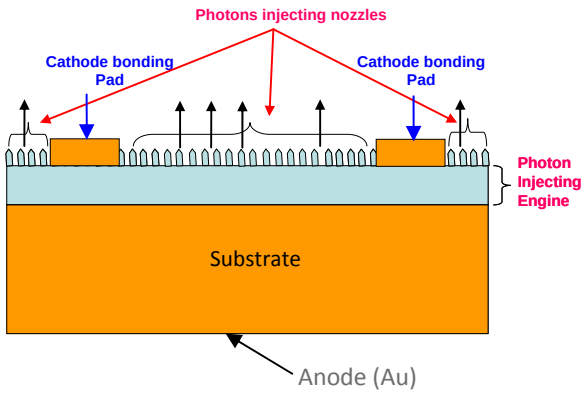
Enhanced Vertical LED Chip

Handling and Package Notes

(Back metal Au)

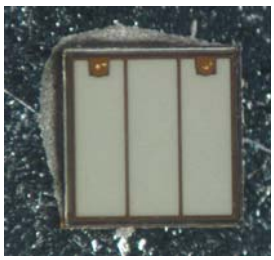
How to get the best performance from EV-LED

The EV™ LED chip can be divided into three parts: metal alloy substrate, photon injection engine, and photon injecting nozzles. The metal alloy, the photon injection engine and photon injecting nozzles are fragile. According to the different mechanical properties of these parts, the user should be very careful to prevent local stress on the chip during the packaging process. Local stress may damage to the LED chip.

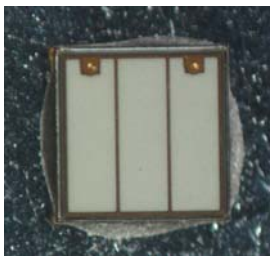


Die Attach Process

Die Attach (also known as Die Bond or Die Mount) is the process of attaching the LED chip to the contact pad of the lead frame in the package. There are three main steps in the die attach process. In the first step, chip adhesive (vie conductive paste or solder) is dispensed on to the contact pad. Then, the die is ejected from the blue tape by a push-up needle which pushes upward on the backside of the die and dislodges the die off the tape. In the third step, a pick-and-place tool picks the die from the tape and positions it on the dispensed adhesive material. All four sides of the chip must show excess die attach material.



X (2 side had solder)



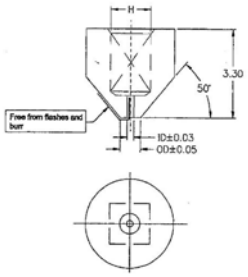
O(4 side had solder)

Automatic Operation

1. Although the junction height is 75~140μm, too much conductive adhesive will cause the device to short.
2. We recommend using an antistatic plastic material push pin tool.
3. The following table shows the recommended dimensions of the push-up needles used for different types of chip sizes.

Chip Size(mil)	p-n Junction Height (μm)	Backside Area (μm x um)	Dimension of push-up needle (Radius: mm)
15*15	75 ± 15	380x380	R≧0.025
35*35	140 ± 15	860x860	R≧0.1
40*40	140 ± 15	1070x1070	R≧0.1
45*45	140 ± 15	1200x1200	R≧0.1
60*60	140 ± 15	1520x1520	R≧0.1

4. Pick-and-place
   (1) We recommend using an antistatic rubber pick-up tool. Do not use pick-up tools made of hard materials like tungsten carbide or steel; these may increase the risk of damages to the chip. The following table shows the different dimensions of rubber tips to be used for different sizes of chip.

Chip Size(mil)	p-n Junction Height (μm)	p-n Junction Area (μm x μm)	Outer dia (O.D., mm)	Internal Dia (I.D., mm)	
15*15	75 ± 15	340x340	0.762	0.350	 Materials : Rubber
35*35	140 ± 15	800x800	1.270	0.550	
40*40	140 ± 15	970x970	1.270	0.550	
45*45	140 ± 15	1050x1050	1.270	0.550	
60*60	140 ± 15	1420x1420	1.524	0.650	

(2) Delay time: Lower suction force is better for EV LED chips. The following example shows the recommended delay times used for different types of chip sizes.

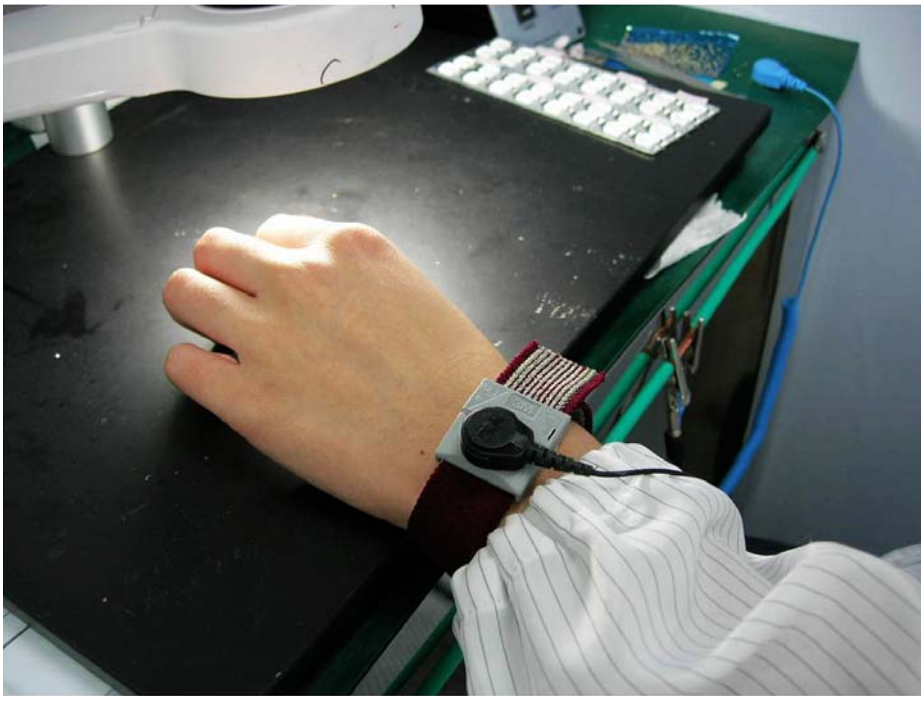
Chip Size(mil)	p-n Junction Height (μm)	p-n Junction Area (μm x μm)	Bond Force For Pick(g)	Bond Force For Bond(g)
15*15	75 +/-15	340x340	35~40	45~50
35*35	140+/-15	800x800	45~60	45~70
40*40	140+/-15	970x970	45~60	45~70
45*45	140+/-15	1050x1050	45~60	45~70
60*60	140+/-15	1420x1420	45~60	45~70

Manual Operation

1. The amount of adhesive (Ag epoxy or solder): Although the junction height is 75~140μm, too much adhesive will cause the p-n junction short. The following table shows the dimensions of the chips SemiLEDs offers.

Chip Size(mil)	p-n Junction Height (μm)	Backside Area (μm x μm)	p-n Junction Area (μm x μm)
15*15	75 ± 15	380x380	340x340
35*35	140 ± 15	860x860	800x800
40*40	140 ± 15	1070x1070	970x970
45*45	140 ± 15	1200x1200	1050x1050
60*60	140 ± 15	1520x1520	1420x1420

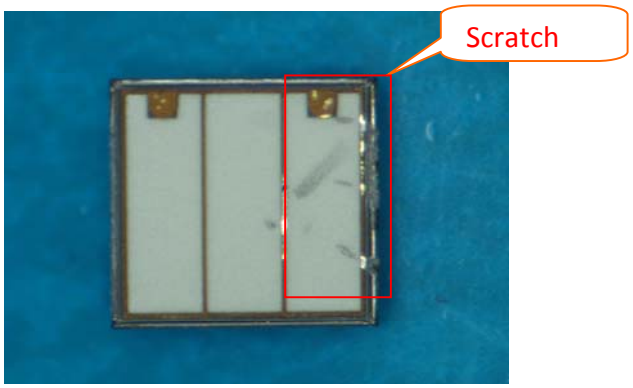
2. Use grounded wrist bands or anti-electrostatic gloves when handling the chips. This is a precautionary measure to prevent chips from possible electrical static discharge(ESD) damage.



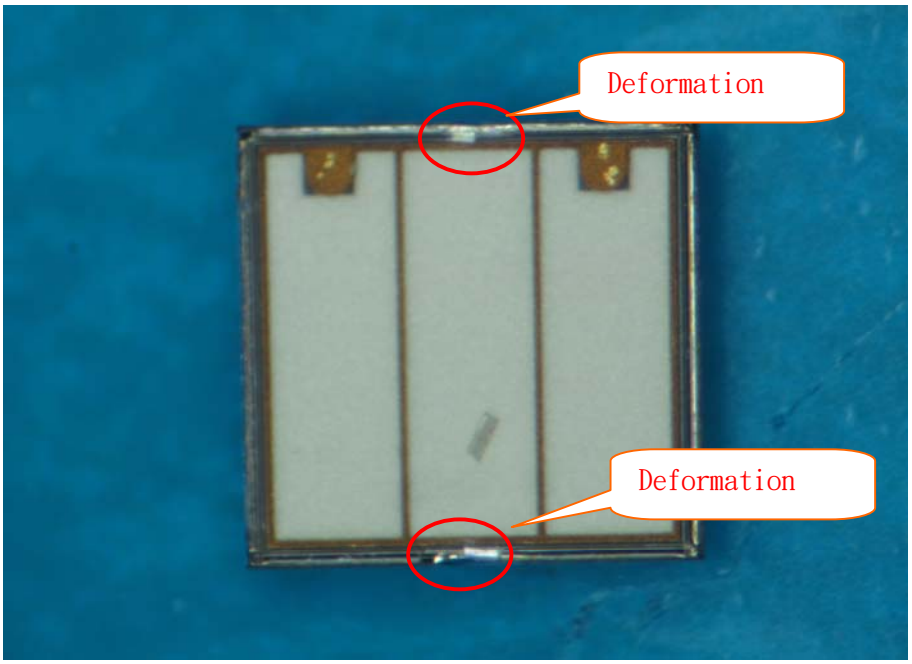
3. Use an ionic fan to prevent chips from possible ESD damage.

4. The blue tape should be peeled from the release paper in front of an ionic fan.

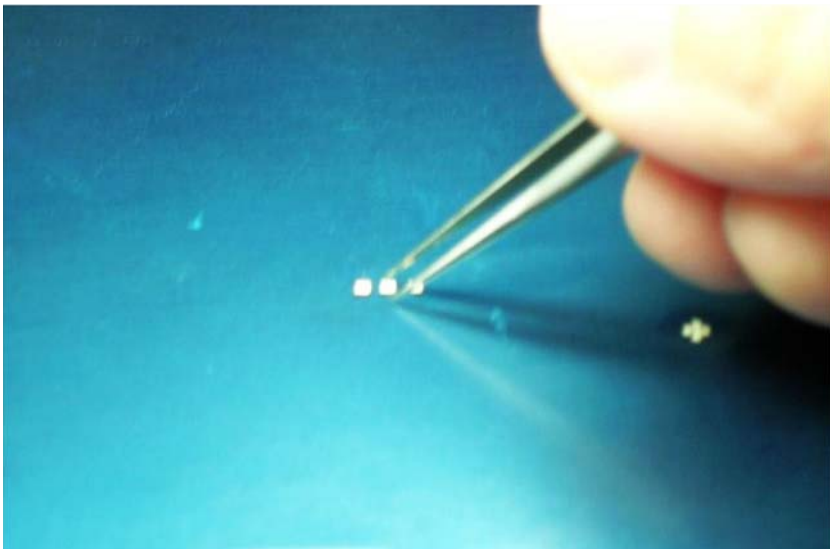
5. The tips of the tweezers should be straight. If the tips are bent, the operation will be more difficult, and the chip may be damaged during the pick-up step. (ie: scratch)



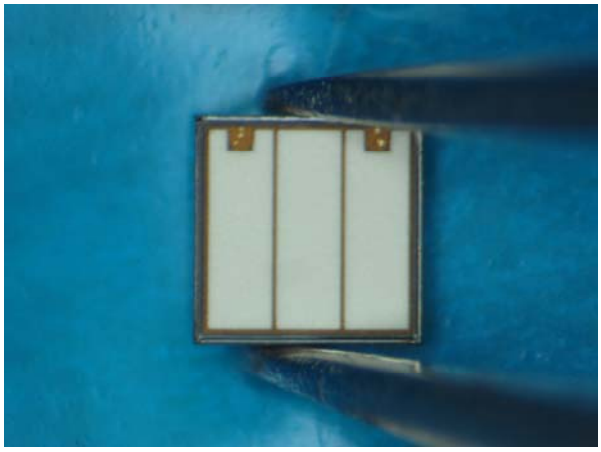
6. SemiLEDs' EV LEDs are composed of a metal alloy substrate. The hardness level of this metal alloy substrate is less than sapphire. Therefore it is strongly recommended a small pick-up force should be used to prevent deformation of the chip.



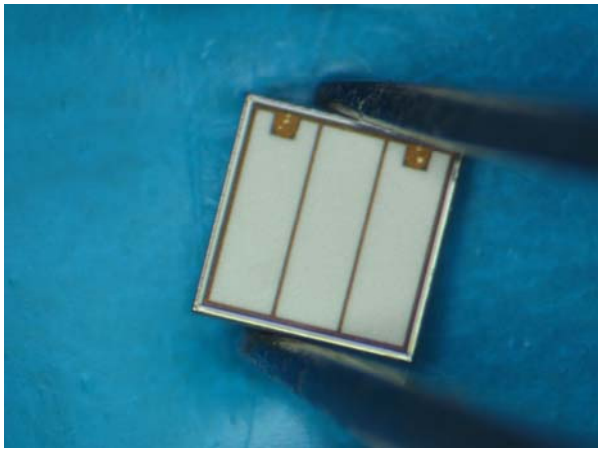
7. Clip the chip and then rotate the chip clockwise. It is very important to make sure that the chip is lifted off of the blue tape before picking up the chip. If the operator picks up the chip without this rotating step, it is easy to damage the chip. (ie: via scratch)



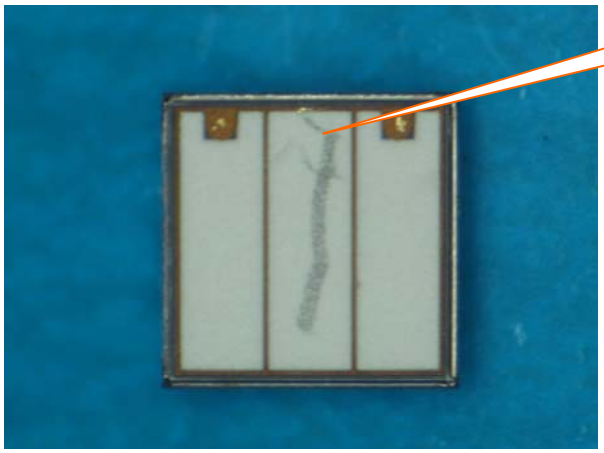
a. Clip the chip with minimal force.



b. Rotate the chip clockwise



c. Make sure that the chip is lifted off of the blue tape. Then, pick up the chip.



d. The tweezers can scratch the surface of chip when the chip is not clipped and rotated correctly.

b. Put the chip onto the die pad of the lead frame. The silver paste should not overflow on to the chip surface.

c. Do not use the tips of the tweezers to press the surface of the chip.

d. Do not scratch the edge and/or front side of the chips.

Note:

In your packaging processes, long steady high temperature will affect the LED and / or other material's quality or performance. (Such as forward voltage increase, luminance decrease). Lower temperature and shorter duration are recommended. As an example, when curing silver epoxy or silicone in the oven, the duration shall be kept less than 10 hours at 150℃ or less than 3 hours at 180℃. If you have any questions regarding your high temperature process. Please contact SEMLEDS support team.

Wire Bond Process

We recommend using gold ball bonding as an electrical connection. A gold ball is first formed by melting the end of the wire through electronic flame-off (EFO). Then, free-air ball is brought into contact with the bond pad on the chip. The bonder applies pressure, heat, and ultrasonic force to the ball to form a metallurgical weld between the ball and the bond pad. Then the wire is run to the lead frame, forming a loop between the bond pad and the lead frame. Pressure and ultrasonic force are applied to the wire to form the second bond.

The bonding force of the first bond should have a lower force, a lower power and be fine tuned to prevent stress which may damage the bond pad and chip. The gold ball can't bond outside the pad area; it will damage the semiconductor layer and cause current leakage. The following example shows the parameters for wire bonding.

Equipment Type: Auto Wire Bonder
Machine Model: ASM W/B machine, Eagle 60 / IHAWK series
Gold Wire Size: 1.5mil Au wire at 160℃ bonding temperature
Capillary: K&S H21CD31T080OR29F11
PR Light Color: Blue

Wire Parameter	Target Value
Bond time (ms)	30
Bond Power (Dac)	95
Bond Force (gf)	57
Contact time (ms)	10
Contact power (mW)	40
Contact force (gf)	20
Stand by power (mW)	20
Power delay (ms)	10

Note: If recognition is difficult with current light source, Please consult SEMILEDS sales team.

Encapsulation Materials

Packaged LED lifetime is not only determined by the chip but also by other materials, like the encapsulation material. Silicone resin together with blue and green EV-LED's show many advantages such as lifetime, brightness, etc…. For UV and Deep UV chips, a glass cover sealed with nitrogen gas is recommended.

Important Note: Most silicone encapsulants available in the market are compatible with EV-LED's. However, in-house tests showed that certain additive material will damage the EV-LED's passivation and increase the risk of leakage current. SemiLEDs recommends using Momentive corp. 1063, Dow corning corp. OE-6636, and OE-6450 as the encapsulant, If you are using other types, please consult with SemiLEDS sales team.

Soldering

After packaging and in assembly, it is recommended to avoid hand soldering. Either reflow process or solder paste (for low process temperature, customer could use low melting point solder, e.g. Sn/Bi solder) with hotplate baking is recommended.

Recommended:

Reflow oven

Hotplate

Avoid:

Hand soldering

ESD Protection

Electrostatic discharge (ESD) may also damage chips. The following precautions may help prevent chips from future or possible ESD damages.

- All equipment must be properly grounded.
- Use grounded wrist bands and / or anti-electrostatic gloves when handling the chips.
- Use an ionic fan in chip transfer and other processes, to prevent chips from future or possible ESD damage.
- It is recommended to build a protection component into the emitter or the module, for example, a zener diode.

About Us

SemiLEDs Corporation is a US company that develops and manufactures ultra-high brightness LED chips and components for general lighting, including street lights and commercial, industrial and residential lighting, along with specialty industrial applications such as UV curing, medical/cosmetic, counterfeit detection and horticulture. SemiLEDs specializes in the development and manufacturing of vertical LED chips in blue (white), green, and UV using a patented copper alloy base. This unique design allows for higher performance and longer lumen maintenance. The World Economic Forum recognized SemiLEDs innovations with the 2009 Technology Pioneer Award. SemiLEDs is fully ISO 9001:2008 Certified SemiLEDs is a publicly traded company on NASDAQ Global Select Market (stock symbol “LEDS”). For investor information, please contact us at investors@semileds.com.
For further company or product information, please visit us at www.semileds.com or please contact sales@ semileds.com.

www.semileds.com

AMERICAS
SemiLEDs Corporation
999 Main Street, Suite 1010
Boise, ID 83702
United States

Tel +1.208.389.7426
Fax +1.208.389.7515
sales@semileds.com

ASIA PACIFIC
3F, No. 11, KeJung Rd.
Chu-Nan Site
Hsinchu Science Park
Chu-Nan 350, Miao-Li County
Taiwan, ROC

Tel: +886-37-586788
Fax: +886-37-582688
sales@semileds.com