Protection Zener Series
A new application in LED field

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1. LED needs protection

**Background**

Electronic systems or components are sensitive to both external and internal sources of overvoltage transients. This can be in the form of external Electro-Static Discharge (**ESD**) or internally generated Electrical Fast Transients (**EFT**).

![ESD wave form](image1)

![EFT BURST](image2)
1. LED needs protection ---Cont’d

Of particular concern are EFT disturbances most often caused by transient currents (commonly called arcing) during a make or break of contact, and sudden changes in the magnitude and direction of currents in everyday office equipment, such as copiers, pencil sharpeners, and power switches.
1. LED needs protection ---Cont’d

High Brightness White/Blue/Green LED lamps with Sapphire substrate are basically fragile by ESD Surge. Wollemi Technical Incorporation’s Zener Diodes are used for the safeguard of LEDs to prevent from ESD surge.
2. How zener diode works (ex. With blue LED)

LED Lite state

LED
Vf≈4.0V
Zener
BV≈5.8V

LED off state

LED
Vf≈4.0V
Zener
BV≈5.8V

Zener protection active

LED
Vf≈1.0V
Zener
BV≈10.0V

ESD pulse
Current Dissipation

LED
BV≈5.8V
Zener
BV≈10.0V

ESD pulse
Current Dissipation
3. Connection of zener diode

Bi-direction connect

Single direction connect

Bi-direction connect

Single direction connect
### 4. Zener diode selection

**Zener Selection reference Table**

<table>
<thead>
<tr>
<th>Item</th>
<th>LED</th>
<th>Zener</th>
<th>Remark</th>
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<tbody>
<tr>
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<tr>
<td></td>
<td>PKG</td>
<td>Type</td>
<td>Dim.</td>
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<tr>
<td>1</td>
<td>RGB</td>
<td>Dual</td>
<td>5.8</td>
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<tr>
<td>2</td>
<td>Blue</td>
<td>Dual</td>
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<tr>
<td>3</td>
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<td>Dual</td>
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<tr>
<td>4</td>
<td>White</td>
<td>Single</td>
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<td>5</td>
<td>Blue</td>
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<td>6</td>
<td>Green</td>
<td>Single</td>
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5. WTI current product line up

<table>
<thead>
<tr>
<th>Item</th>
<th>Chip type</th>
<th>Chip size (mil)</th>
<th>Zener Voltage Vz (V)</th>
<th>Annotation</th>
<th>Pattern</th>
<th>LED Circuit</th>
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<tbody>
<tr>
<td>ZW02-5.8-SAL8</td>
<td>P/N</td>
<td>8<em>8</em>5</td>
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<td>1. One Al wire bonding Pad</td>
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<td>ZW02-5.8-SAL8S</td>
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<td>3. Standard products</td>
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<td>2. Parallel with two LED</td>
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<td>2. Parallel with one LED</td>
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<td>3. Preliminary products</td>
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<td>2. Parallel with one LED</td>
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<td>3. Standard products</td>
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</table>
6. FAQ

1.) What is zener diode for in LED application?  
   Ans: ESD/EFT power dissipation.

2.) Why need to use this zener in LED?  
   Ans: Protect Blue/Green/White LED chips.

3.) Which LED need to use this zener in LED?  
   Ans: Blue/Green/White.

4.) How to use this zener in LED?  
   Ans: Reverse parallel connected with LED  
   or use bi-direction connection.

5.) How can I measure reverse leakage of LED?  
   Ans: Use bi-direction zener instead.

6.) What is the min. thickness of zener diode?  
   Ans: 4 mil available by request.

7.) Pad metal Ag & Al, which's better?  
   Ans: It depends on customer’s bonding parameter.

8.) Can provide fully tested chips?  
   Ans: Yes! But cost more.

9.) What is the ESD performance?  
   Ans: Per Jedec std. our zener can survive  
       through 8000V/HBM with 8 mil chip

10) Why the top surface of your some series is not planar?  
    Ans: Because we use Al alloy diffusion technique it need a guard ring to keep all parameter in spec.
7. Appendix

HBM (Human Body Mode): Per JESD22-A114-B

CLASS 0: Any part that fails after exposure to an ESD pulse of 250 volts or less.

CLASS 1A: Any part that passes after exposure to an ESD pulse of 250 volts but fails after exposure to an ESD pulse of 500 volts.

CLASS 1B: Any part that passes after exposure to an ESD pulse of 500 volts, but fails after exposure to an ESD pulse of 1000 volts.

CLASS 1C: Any part that passes after exposure to an ESD pulse of 1000 volts, but fails after exposure to an ESD pulse of 2000 volts.

CLASS 2: Any part that passes after exposure to an ESD pulse of 2000 volts, but fails after exposure to an ESD pulse of 4000 volts.

CLASS 3A: Any part that passes after exposure to an ESD pulse of 4000 volts, but fails after exposure to an ESD pulse of 8000 volts.

CLASS 3B: Any part that passes after exposure to an ESD pulse of 8000 volts.
7. Appendix---Cont’d

MM(Machine Mode): Per JESD22-A115-A

**CLASS A:** Any part that fails after exposure to an ESD pulse of 200 volts or less.

**CLASS B:** Any part that passes after exposure to an ESD pulse of 200 volts, but fails after exposure to an ESD pulse of 400 volts.

**CLASS C:** Any part that passes after exposure to an ESD pulse of 400 volts.
7. Appendix---Cont’d

Per MIL-STD-883E

Class 1  0 volt to 1,999 volts
Class 2  2,000 volts to 3,999 volts
Class 3  4,000 volts and above
7. Appendix---Cont’d

R1 = 106 ohms to 107 ohms
C1 = 100 picofarads ±10 percent (Insulation resistance 1012 ohms minimum)
R2 = 1,500 ohms ±1 percent
S1 = High voltage relay (Bounceless, mercury wetted, or equivalent)
S2 = Normally closed switch (Open during discharge pulse and capacitance measurement)

7. Appendix---Cont’d

IEC 61000-4-4: Electrical Fast Transient/Burst

1 - Well Protected  
2 - Protected  
3 - Typical Industrial  
4 - Severe Industrial

<table>
<thead>
<tr>
<th>Level</th>
<th>$V_{oc}$ (kV)</th>
<th>$I_{sc}$ (A)</th>
<th>$V_{oc}$ (kV)</th>
<th>$I_{sc}$ (A)</th>
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