LITEON®
OPTOELECTRONICS

# SMD LED

## Product Data Sheet

## LTW-089E2CG-A

**Spec No.: DS22-2008-0061**

Effective Date: 09/06/2008

Revision: D

**LITE-ON DCC**

**RELEASE**

BNS-OD-FC001/A4

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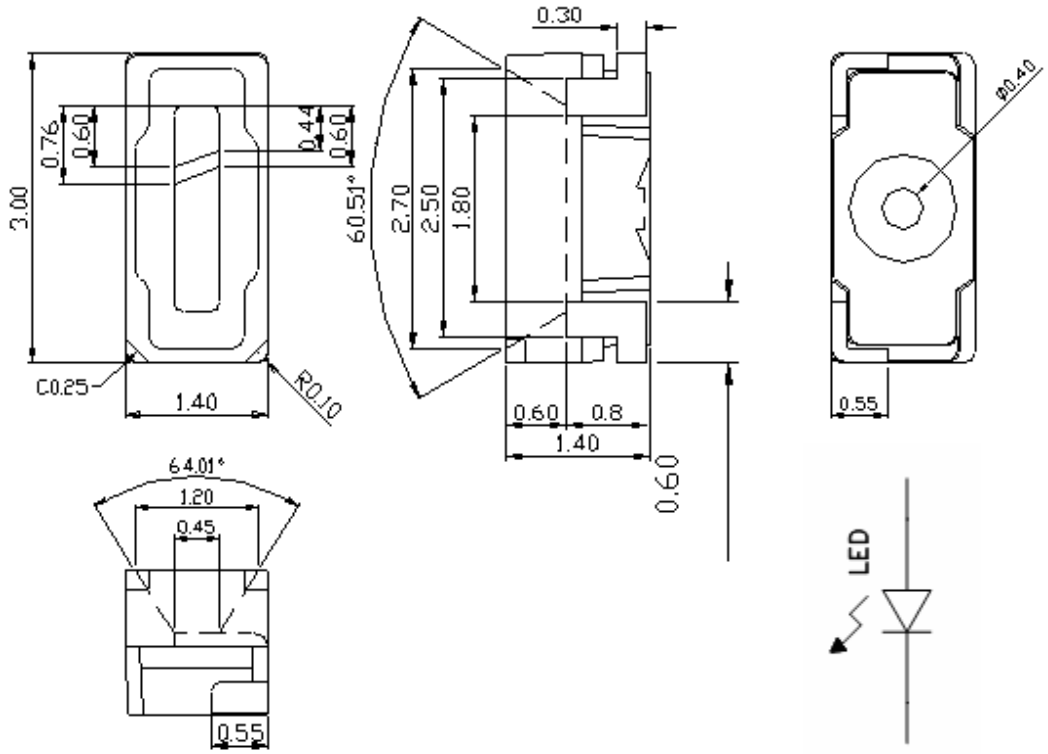
**Features**

* Package in 8mm tape on 7" diameter reels.
* Compatible with automatic placement equipment.
* Compatible with infrared and vapor phase reflow solder process.
* EIA STD package.
* I.C. compatible.
* Meet green product and Pb-free(According to RoHS)

**Package Dimensions**

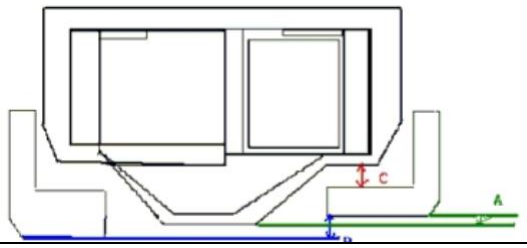



| Part No. | Lens Color | Source Color |
|---|---|---|
| LTW-089E2CG-A | Yellow | InGaN White |

Notes:

1. All dimensions are in millimeters (inches).
2. Tolerance is ±0.1 mm (.004") unless otherwise noted.

**Definition of Distance Between of PAD and Reflector**



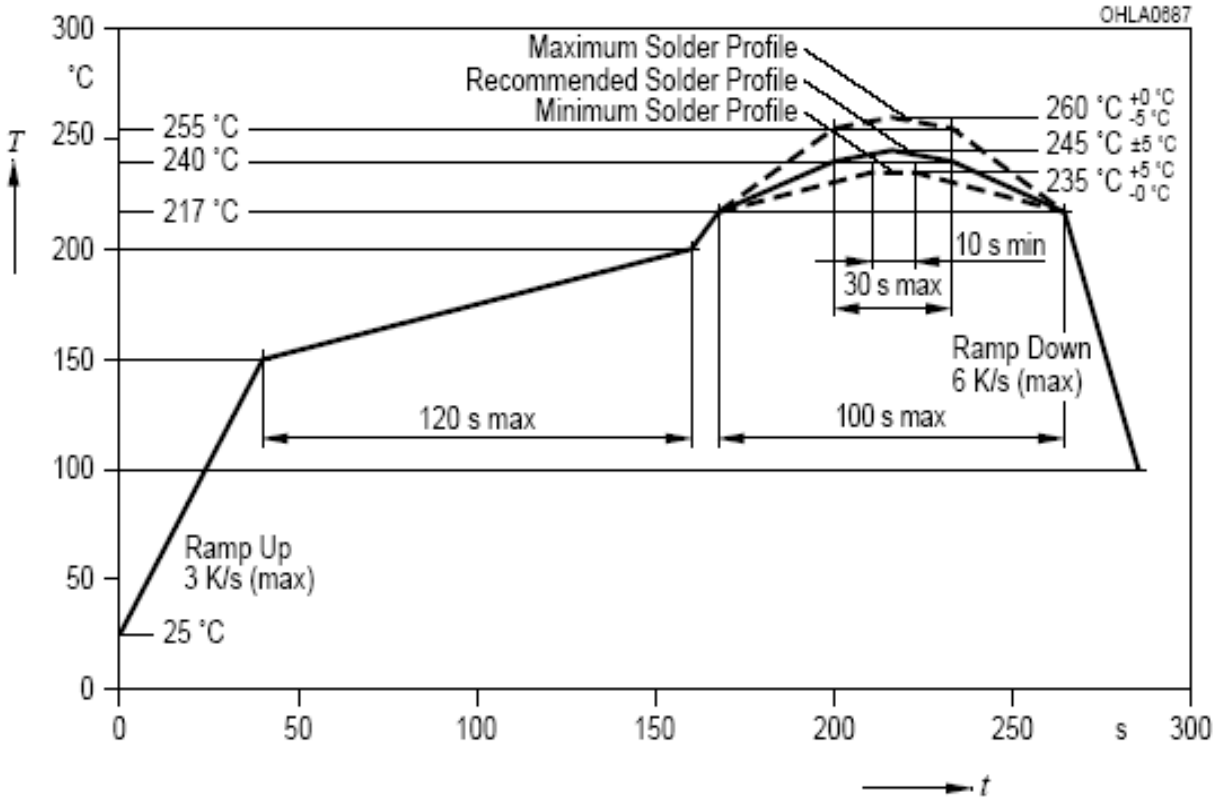

| | Symbol | Dimension (mm) | | | |
|---|---|---|---|---|---|
| A: The distance between pad's bottom and reflector. | A | 0 | min | 0.05 | max |
| B: The tolerance between right and left pad. | B | 0 | min | 0.03 | max |
| C: The distance between pad and reflector. | C | 0 | min | 0.05 | max |

**Absolute Maximum Ratings at Ta=25℃**

| Parameter | LTW-089E2CG-A | Unit |
|---|---|---|
| Power Dissipation (30mA, 4V) | 120 | mW |
| Power Dissipation (20mA, 3.5V) | 70 | mW |
| Peak Forward Current (1/10 Duty Cycle, 0.1ms Pulse Width) | 100 | mA |
| DC Forward Current | 30 | mA |
| Reverse Voltage | 5 | V |
| Operating Temperature Range | -30℃ to + 85℃ | |
| Storage Temperature Range | -40℃ to + 100℃ | |
| Reflow Soldering Condition | 260℃ For 10 Seconds | |

Suggest IR Reflow Condition :

**R-Reflow Soldering Profile for lead free soldering** (Acc. to J-STD-020B)



**Electrical Optical Characteristics At Ta=25℃**

| Parameter | Symbol | Part No. LTW- | Min. | Typ. | Max. | Unit | Test Condition |
|---|---|---|---|---|---|---|---|
| Luminous Flux | lm | 089E2CG-A | 4.0 | | 6.6 | lm | IF = 20mA Note 1, 2 |
| Luminous Intensity | Iv | 089E2CG-A | | 2000 | | | IF = 20mA Note 1, 2 |
| Viewing Angle | 2θ 1/2 | 089E2CG-A | | 120 | | deg | Fig.6 |
| Chromaticity Coordinates | x | 089E2CG-A | | 0.300 | | | IF = 20mA Note 3, 5, 6 |
| | y | | | 0.285 | | | |
| Forward Voltage | VF | 089E2CG-A | 3.0 | 3.2 | 3.4 | V | IF = 20mA |
| ESD-Withstand Voltage | ESD | 089E2CG-A | 1K | | | V | HBM |

Note : 1. Luminous Flux is measured with a light sensor and filter combination that approximates the CIE eye-response curve.

2. Flux classification code is marked on each packing bag.

3. The chromaticity coordinates (x, y) is derived from the 1931 CIE chromaticity diagram.

4. Caution in ESD:

Static Electricity and surge damages the LED. It is recommend to use a wrist band or anti-electrostatic glove when handling the LED. All devices, equipment and machinery must be properly grounded.

5. CAS140B is the test standard for the chromaticity coordinates (x, y)

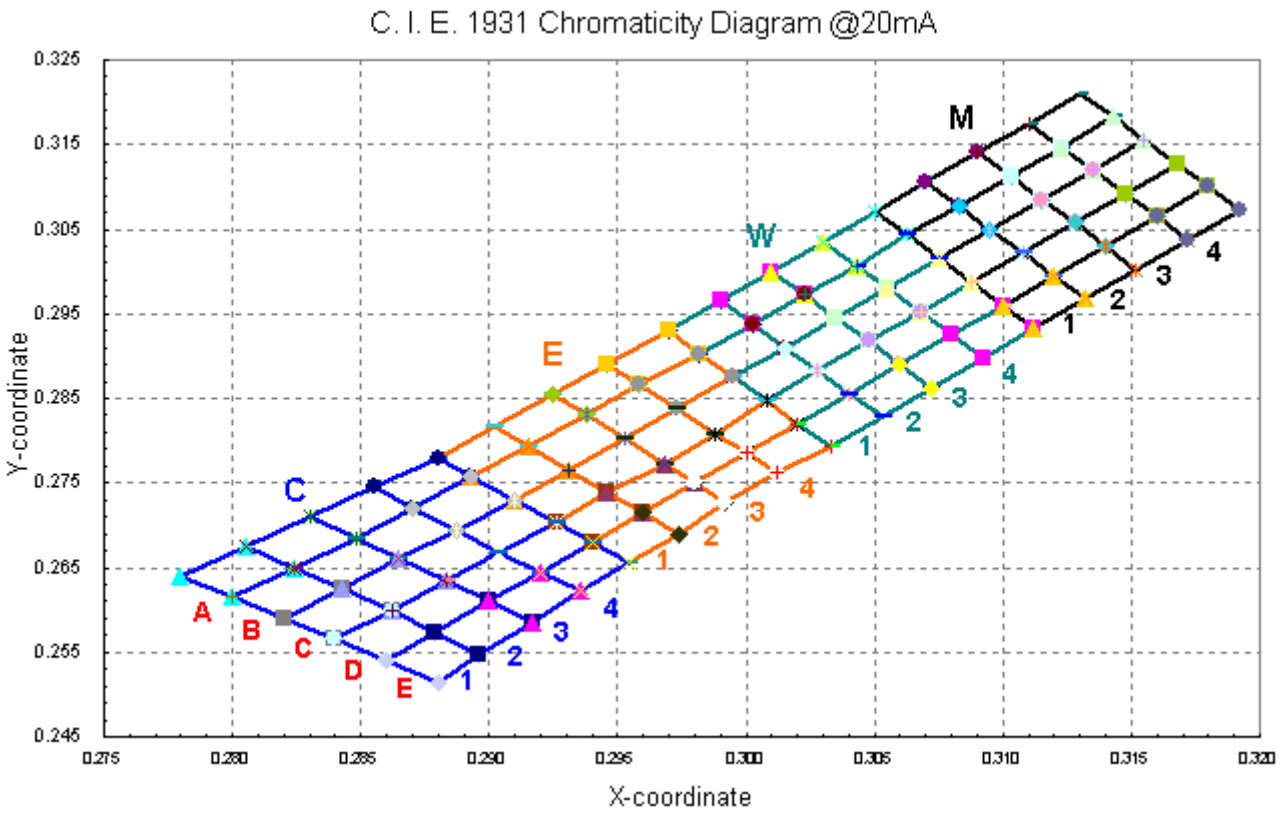
6. Chromaticity coordinates (x, y) is tested by IS.

7. The chromaticity coordinates (x, y) guarantee should be added +/- 0.005 tolerance.

**Bin Code List**

| Luminous Spec. Table | | | | |
|---|---|---|---|---|
| IV Bin | Flux (lm) and IV (mcd) at IF = 20mA | | | |
| | lm | | mcd | |
| | Min. | Max. | Min. | Max. |
| 5 | 4.0 | 4.3 | 1550 | 1650 |
| 6 | 4.3 | 4.6 | 1650 | 1750 |
| 7 | 4.6 | 4.9 | 1750 | 1850 |
| 8 | 4.9 | 5.3 | 1850 | 2000 |
| 9 | 5.3 | 5.7 | 2000 | 2150 |
| 10 | 5.7 | 6.1 | 2150 | 2300 |
| 11 | 6.1 | 6.6 | 2300 | 2500 |

Tolerance on each Luminous Intensity bin and Luminous Flux are +/- 7%, and IV (mcd) is for reference.



**Color Spec. Table @20mA**

| CA1 | | CA2 | | CA3 | | CA4 | |
|---|---|---|---|---|---|---|---|
| x | y | x | y | x | y | x | y |
| 0.2800 | 0.2615 | 0.2824 | 0.2649 | 0.2848 | 0.2684 | 0.2870 | 0.2720 |
| 0.2780 | 0.2640 | 0.2805 | 0.2675 | 0.2830 | 0.2710 | 0.2855 | 0.2745 |
| 0.2805 | 0.2675 | 0.2830 | 0.2710 | 0.2855 | 0.2745 | 0.2880 | 0.2780 |
| 0.2824 | 0.2649 | 0.2848 | 0.2684 | 0.2870 | 0.2720 | 0.2893 | 0.2758 |
| **CB1** | | **CB2** | | **CB3** | | **CB4** | |
| 0.2820 | 0.2590 | 0.2843 | 0.2625 | 0.2865 | 0.2660 | 0.2887 | 0.2694 |
| 0.2800 | 0.2615 | 0.2824 | 0.2649 | 0.2848 | 0.2684 | 0.2870 | 0.2720 |
| 0.2824 | 0.2649 | 0.2848 | 0.2684 | 0.2870 | 0.2720 | 0.2893 | 0.2758 |
| 0.2843 | 0.2625 | 0.2865 | 0.2660 | 0.2887 | 0.2694 | 0.2910 | 0.2730 |
| **CC1** | | **CC2** | | **CC3** | | **CC4** | |
| 0.2840 | 0.2565 | 0.2862 | 0.2598 | 0.2883 | 0.2634 | 0.2904 | 0.2668 |
| 0.2820 | 0.2590 | 0.2843 | 0.2625 | 0.2865 | 0.2660 | 0.2887 | 0.2694 |
| 0.2843 | 0.2625 | 0.2865 | 0.2660 | 0.2887 | 0.2694 | 0.2910 | 0.2730 |
| 0.2862 | 0.2598 | 0.2883 | 0.2634 | 0.2904 | 0.2668 | 0.2926 | 0.2703 |
| **CD1** | | **CD2** | | **CD3** | | **CD4** | |
| 0.2860 | 0.2540 | 0.2879 | 0.2573 | 0.2900 | 0.2610 | 0.2920 | 0.2645 |
| 0.2840 | 0.2565 | 0.2862 | 0.2598 | 0.2883 | 0.2634 | 0.2904 | 0.2668 |
| 0.2862 | 0.2598 | 0.2883 | 0.2634 | 0.2904 | 0.2668 | 0.2926 | 0.2703 |
| 0.2879 | 0.2573 | 0.2900 | 0.2610 | 0.2920 | 0.2645 | 0.2940 | 0.2680 |
| **CE1** | | **CE2** | | **CE3** | | **CE4** | |
| 0.2860 | 0.2540 | 0.2879 | 0.2573 | 0.2900 | 0.2610 | 0.2920 | 0.2645 |
| 0.2880 | 0.2515 | 0.2896 | 0.2548 | 0.2917 | 0.2586 | 0.2936 | 0.2622 |
| 0.2896 | 0.2548 | 0.2917 | 0.2586 | 0.2936 | 0.2622 | 0.2954 | 0.2657 |
| 0.2879 | 0.2573 | 0.2900 | 0.2610 | 0.2920 | 0.2645 | 0.2940 | 0.2680 |
| **EA1** | | **EA2** | | **EA3** | | **EA4** | |
| x | y | x | y | x | y | x | y |
| 0.2893 | 0.2758 | 0.2915 | 0.2794 | 0.2938 | 0.2831 | 0.2958 | 0.2867 |
| 0.2880 | 0.2780 | 0.2902 | 0.2816 | 0.2925 | 0.2855 | 0.2946 | 0.2890 |
| 0.2902 | 0.2816 | 0.2925 | 0.2855 | 0.2946 | 0.2890 | 0.2970 | 0.2930 |
| 0.2915 | 0.2794 | 0.2938 | 0.2831 | 0.2958 | 0.2867 | 0.2982 | 0.2903 |
| **EB1** | | **EB2** | | **EB3** | | **EB4** | |
| 0.2910 | 0.2730 | 0.2931 | 0.2765 | 0.2953 | 0.2803 | 0.2973 | 0.2838 |
| 0.2893 | 0.2758 | 0.2915 | 0.2794 | 0.2938 | 0.2831 | 0.2958 | 0.2867 |
| 0.2915 | 0.2794 | 0.2938 | 0.2831 | 0.2958 | 0.2867 | 0.2982 | 0.2903 |
| 0.2931 | 0.2765 | 0.2953 | 0.2803 | 0.2973 | 0.2838 | 0.2995 | 0.2875 |
| **EC1** | | **EC2** | | **EC3** | | **EC4** | |
| 0.2926 | 0.2703 | 0.2946 | 0.2738 | 0.2968 | 0.2773 | 0.2988 | 0.2808 |
| 0.2910 | 0.2730 | 0.2931 | 0.2765 | 0.2953 | 0.2803 | 0.2973 | 0.2838 |
| 0.2931 | 0.2765 | 0.2953 | 0.2803 | 0.2973 | 0.2838 | 0.2995 | 0.2875 |
| 0.2946 | 0.2738 | 0.2968 | 0.2773 | 0.2988 | 0.2808 | 0.3008 | 0.2848 |
| **ED1** | | **ED2** | | **ED3** | | **ED4** | |
| 0.2940 | 0.2680 | 0.2960 | 0.2714 | 0.2980 | 0.2750 | 0.3000 | 0.2785 |
| 0.2926 | 0.2703 | 0.2946 | 0.2738 | 0.2968 | 0.2773 | 0.2988 | 0.2808 |
| 0.2946 | 0.2738 | 0.2968 | 0.2773 | 0.2988 | 0.2808 | 0.3008 | 0.2848 |
| 0.2960 | 0.2714 | 0.2980 | 0.2750 | 0.3000 | 0.2785 | 0.3020 | 0.2820 |
| **EE1** | | **EE2** | | **EE3** | | **EE4** | |
| 0.2940 | 0.2680 | 0.2960 | 0.2714 | 0.2980 | 0.2750 | 0.3000 | 0.2785 |
| 0.2954 | 0.2657 | 0.2974 | 0.2690 | 0.2992 | 0.2727 | 0.3012 | 0.2762 |
| 0.2974 | 0.2690 | 0.2992 | 0.2727 | 0.3012 | 0.2762 | 0.3033 | 0.2793 |
| 0.2960 | 0.2714 | 0.2980 | 0.2750 | 0.3000 | 0.2785 | 0.3020 | 0.2820 |

Color Coordinates Measurement allowance is ±0.005

**Color Spec. Table @20mA**

| WA1 | | WA2 | | WA3 | | WA4 | |
|---|---|---|---|---|---|---|---|
| x | y | x | y | x | y | x | y |
| 0.2982 | 0.2903 | 0.3003 | 0.2937 | 0.3023 | 0.2973 | 0.3043 | 0.3007 |
| 0.2970 | 0.2930 | 0.2990 | 0.2965 | 0.3010 | 0.3000 | 0.3030 | 0.3035 |
| 0.2990 | 0.2965 | 0.3010 | 0.3000 | 0.3030 | 0.3035 | 0.3050 | 0.3070 |
| 0.3003 | 0.2937 | 0.3023 | 0.2973 | 0.3043 | 0.3007 | 0.3063 | 0.3043 |
| **WB1** | | **WB2** | | **WB3** | | **WB4** | |
| 0.2995 | 0.2875 | 0.3015 | 0.2910 | 0.3035 | 0.2945 | 0.3055 | 0.2980 |
| 0.2982 | 0.2903 | 0.3003 | 0.2937 | 0.3023 | 0.2973 | 0.3043 | 0.3007 |
| 0.3003 | 0.2937 | 0.3023 | 0.2973 | 0.3043 | 0.3007 | 0.3063 | 0.3043 |
| 0.3015 | 0.2910 | 0.3035 | 0.2945 | 0.3055 | 0.2980 | 0.3075 | 0.3015 |
| **WC1** | | **WC2** | | **WC3** | | **WC4** | |
| 0.3008 | 0.2848 | 0.3028 | 0.2883 | 0.3048 | 0.2918 | 0.3068 | 0.2952 |
| 0.2995 | 0.2875 | 0.3015 | 0.2910 | 0.3035 | 0.2945 | 0.3055 | 0.2980 |
| 0.3015 | 0.2910 | 0.3035 | 0.2945 | 0.3055 | 0.2980 | 0.3075 | 0.3015 |
| 0.3028 | 0.2883 | 0.3048 | 0.2918 | 0.3068 | 0.2952 | 0.3088 | 0.2988 |
| **WD1** | | **WD2** | | **WD3** | | **WD4** | |
| 0.3020 | 0.2820 | 0.3040 | 0.2855 | 0.3060 | 0.2890 | 0.3080 | 0.2925 |
| 0.3008 | 0.2848 | 0.3028 | 0.2883 | 0.3048 | 0.2918 | 0.3068 | 0.2952 |
| 0.3028 | 0.2883 | 0.3048 | 0.2918 | 0.3068 | 0.2952 | 0.3088 | 0.2988 |
| 0.3040 | 0.2855 | 0.3060 | 0.2890 | 0.3080 | 0.2925 | 0.3100 | 0.2960 |
| **WE1** | | **WE2** | | **WE3** | | **WE4** | |
| 0.3020 | 0.2820 | 0.3040 | 0.2855 | 0.3060 | 0.2890 | 0.3080 | 0.2925 |
| 0.3033 | 0.2793 | 0.3053 | 0.2828 | 0.3072 | 0.2862 | 0.3092 | 0.2898 |
| 0.3053 | 0.2828 | 0.3072 | 0.2862 | 0.3092 | 0.2898 | 0.3112 | 0.2932 |
| 0.3040 | 0.2855 | 0.3060 | 0.2890 | 0.3080 | 0.2925 | 0.3100 | 0.2960 |
| **MA1** | | **MA2** | | **MA3** | | **MA4** | |
| x | y | x | y | x | y | x | y |
| 0.3063 | 0.3043 | 0.3083 | 0.3077 | 0.3103 | 0.3113 | 0.3123 | 0.3147 |
| 0.3050 | 0.3070 | 0.3070 | 0.3105 | 0.3090 | 0.3140 | 0.3110 | 0.3175 |
| 0.3070 | 0.3105 | 0.3090 | 0.3140 | 0.3110 | 0.3175 | 0.3130 | 0.3210 |
| 0.3083 | 0.3077 | 0.3103 | 0.3113 | 0.3123 | 0.3147 | 0.3143 | 0.3183 |
| **MB1** | | **MB2** | | **MB3** | | **MB4** | |
| 0.3075 | 0.3015 | 0.3095 | 0.3050 | 0.3115 | 0.3085 | 0.3135 | 0.3120 |
| 0.3063 | 0.3043 | 0.3083 | 0.3077 | 0.3103 | 0.3113 | 0.3123 | 0.3147 |
| 0.3083 | 0.3077 | 0.3103 | 0.3113 | 0.3123 | 0.3147 | 0.3143 | 0.3183 |
| 0.3095 | 0.3050 | 0.3115 | 0.3085 | 0.3135 | 0.3120 | 0.3155 | 0.3155 |
| **MC1** | | **MC2** | | **MC3** | | **MC4** | |
| 0.3088 | 0.2988 | 0.3108 | 0.3022 | 0.3128 | 0.3058 | 0.3148 | 0.3092 |
| 0.3075 | 0.3015 | 0.3095 | 0.3050 | 0.3115 | 0.3085 | 0.3135 | 0.3120 |
| 0.3095 | 0.3050 | 0.3115 | 0.3085 | 0.3135 | 0.3120 | 0.3155 | 0.3155 |
| 0.3108 | 0.3022 | 0.3128 | 0.3058 | 0.3148 | 0.3092 | 0.3168 | 0.3128 |
| **MD1** | | **MD2** | | **MD3** | | **MD4** | |
| 0.3100 | 0.2960 | 0.3120 | 0.2995 | 0.3140 | 0.3030 | 0.3160 | 0.3065 |
| 0.3088 | 0.2988 | 0.3108 | 0.3022 | 0.3128 | 0.3058 | 0.3148 | 0.3092 |
| 0.3108 | 0.3022 | 0.3128 | 0.3058 | 0.3148 | 0.3092 | 0.3168 | 0.3128 |
| 0.3120 | 0.2995 | 0.3140 | 0.3030 | 0.3160 | 0.3065 | 0.3180 | 0.3100 |
| **ME1** | | **ME2** | | **ME3** | | **ME4** | |
| 0.3100 | 0.2960 | 0.3120 | 0.2995 | 0.3140 | 0.3030 | 0.3160 | 0.3065 |
| 0.3112 | 0.2932 | 0.3132 | 0.2968 | 0.3152 | 0.3002 | 0.3172 | 0.3038 |
| 0.3132 | 0.2968 | 0.3152 | 0.3002 | 0.3172 | 0.3038 | 0.3192 | 0.3072 |
| 0.3120 | 0.2995 | 0.3140 | 0.3030 | 0.3160 | 0.3065 | 0.3180 | 0.3100 |

Color Coordinates Measurement allowance is ±0.005

## Typical Electrical / Optical Characteristics Curves

## (25°C Ambient Temperature Unless Otherwise Noted)

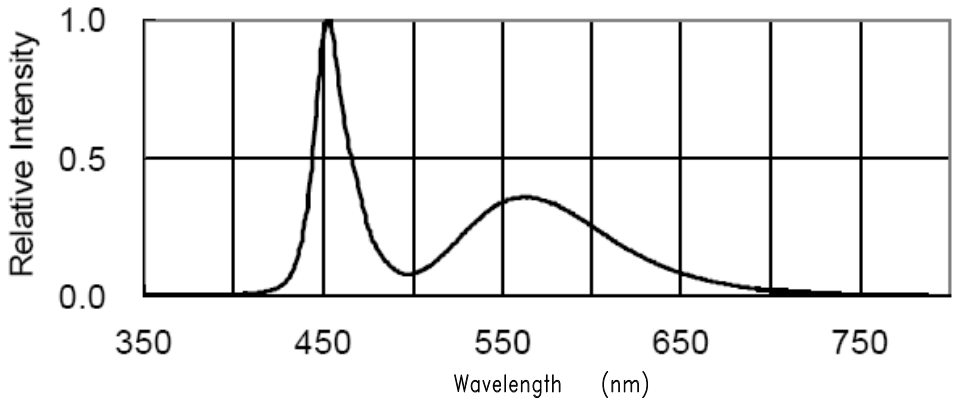



Fig.1 RELATIVE INTENSITY VS. WAVELENGTH

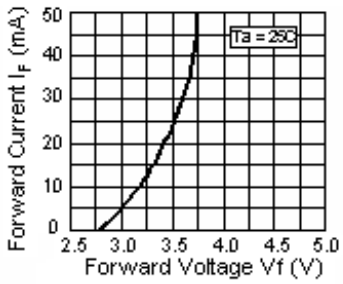



Fig.2 Forward Current vs. Forward Voltage

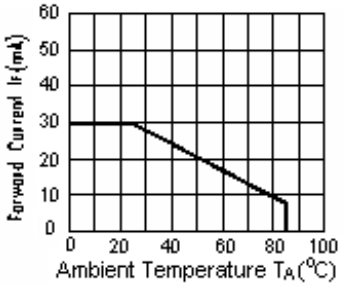



Fig.3 Forward Current Derating Curve

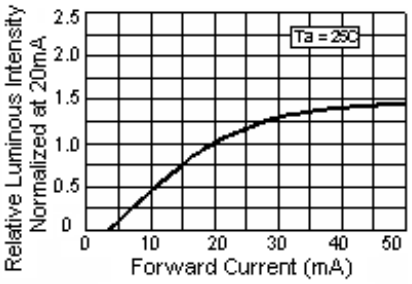



Fig.4 Relative Luminous Intensity vs. Forward Current

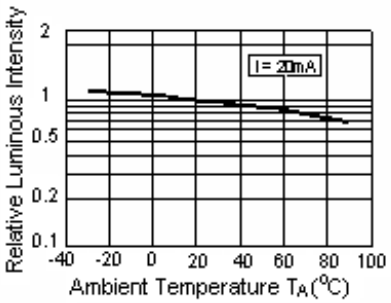



Fig.5 Luminous Intensity vs. AMbient Temperature

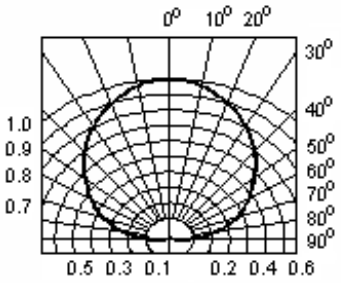



Fig.6 Spatial Distribution

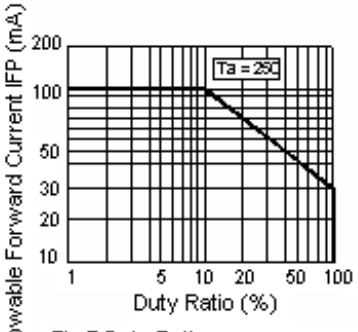



Fig.7 Duty Ratio vs. Allowable Forward Current

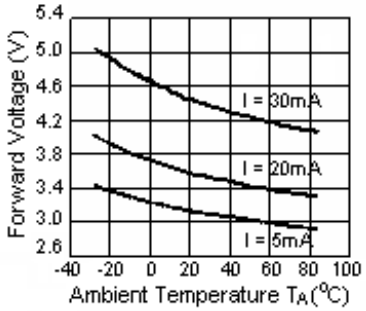



Fig.8 Ambient Temperature vs. Forward Voltage

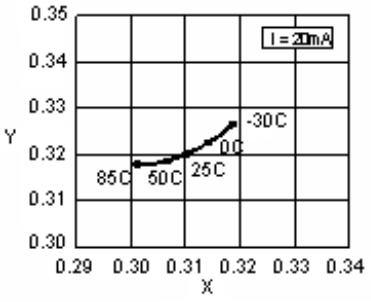



Fig.9 Ambient Temperature vs. Chromaticity Coordinate

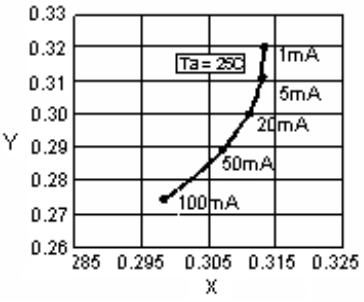



Fig.10 Forward Current vs. Chromaticity Coordinate

## User Guide

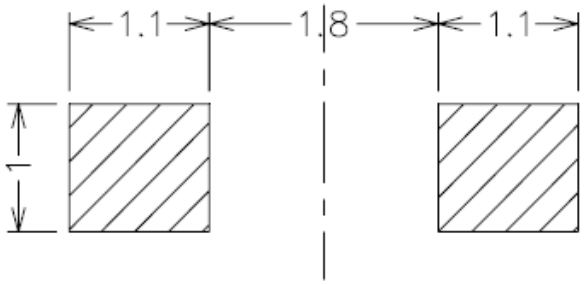
### Cleaning

Do not use unspecified chemical liquid to clean LED they could harm the package. If cleaning is necessary, immerse the LED in ethyl alcohol or isopropyl alcohol at normal temperature for less one minute.

### Recommend Printed Circuit Board Attachment Pad

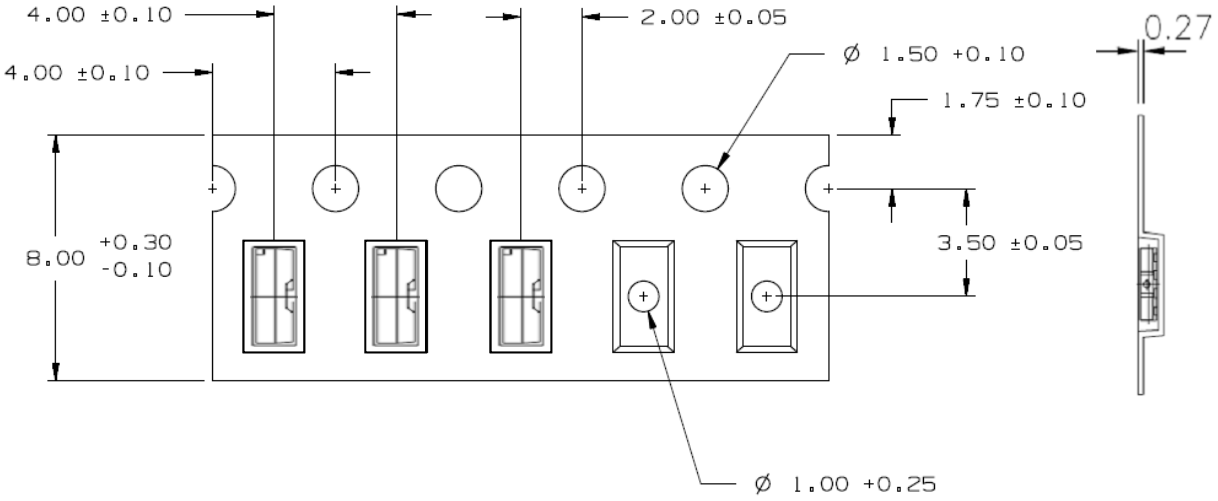
Infrared / vapor phase

Reflow Soldering



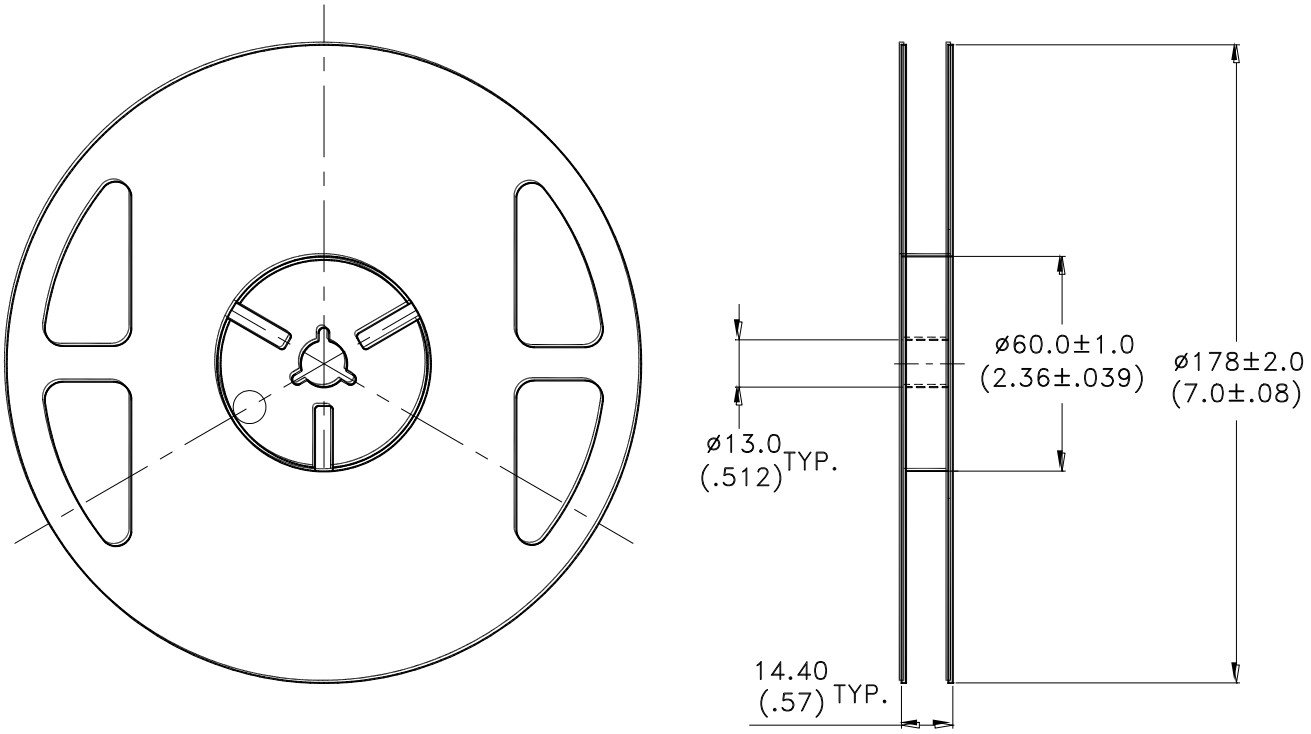

Soldering patterns

### Package Dimensions of Tape




Note: 1.All dimensions are in millimeters (inches).

**Package Dimensions of Reel**




Notes:

1. Empty component pockets sealed with top cover tape.
2. 7 inch reel-2000 pieces per reel.
3. The maximum number of consecutive missing lamps is two.
4. In accordance with EIA-481-1-B specifications.
5. Vacate 20 cm (min) on start of packing tape and vacate 50 cm (min) on last of packing tape.

# CAUTIONS

**1. Application**

The LEDs described here are intended to be used for ordinary electronic equipment (such as office equipment, communication equipment and household applications).Consult Liteon's Sales in advance for information on applications in which exceptional reliability is required, particularly when the failure or malfunction of the LEDs may directly jeopardize life or health (such as in aviation, transportation, traffic control equipment, medical and life support systems and safety devices).

**2. Storage**

This product is qualified as Moisture sensitive Level 3 per JEDEC J-STD-020 Precaution when handing this moisture sensitive product is important to ensure the reliability of the product.

The package is sealed:

The LEDs should be stored at 30℃ or less and 90%RH or less. And the LEDs are limited to use within one year, while the LEDs is packed in moisture-proof package with the desiccants inside.

The package is opened:

The LEDs should be stored at 30℃ or less and 60%RH or less. Moreover, the LEDs are limited to solder process within 168hrs. If the Humidity Indicator shows the pink color in 10% even higher or exceed the storage limiting time since opened, that we recommended to baking LEDs at 60℃ at least 48hrs. To seal the remainder LEDs return to package, it's recommended to be with workable desiccants in original package.

**3. Cleaning**

Use alcohol-based cleaning solvents such as isopropyl alcohol to clean the LED if necessary.

**4. Soldering**

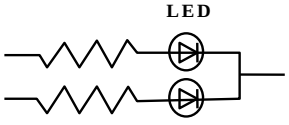
Recommended soldering conditions:

| Reflow soldering | | Soldering iron | |
|---|---|---|---|
| Pre-heat | 120~150℃ | Temperature | 300℃ Max. |
| Pre-heat time | 120 sec. Max. | Soldering time | 3 sec. Max. |
| Peak temperature | 260℃ Max. | | (one time only) |
| Soldering time | 30 sec. Max. | | |

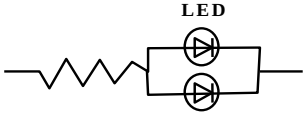
**5. Drive Method**

An LED is a current-operated device. In order to ensure intensity uniformity on multiple LEDs connected in parallel in an application, it is recommended that a current limiting resistor be incorporated in the drive circuit, in series with each LED as shown in Circuit A below.

**Circuit model A**




**Circuit model B**




(A) Recommended circuit.

(B) The brightness of each LED might appear different due to the differences in the I-V characteristics of those LEDs.

**6. ESD (Electrostatic Discharge)**

Static Electricity or power surge will damage the LED.

Suggestions to prevent ESD damage:

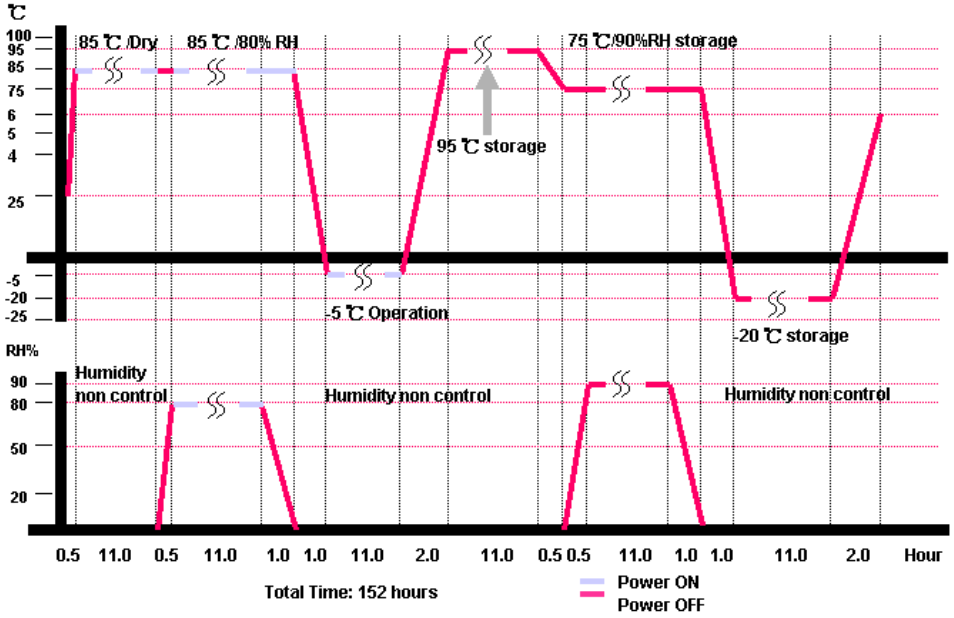
- Use of a conductive wrist band or anti-electrostatic glove when handling these LEDs.
- All devices, equipment, and machinery must be properly grounded.
- Work tables, storage racks, etc. should be properly grounded.
- Use ion blower to neutralize the static charge which might have built up on surface of the LED's plastic lens as a result of friction between LEDs during storage and handling.

ESD-damaged LEDs will exhibit abnormal characteristics such as high reverse leakage current, low forward voltage, or " no lightup " at low currents.
To verify for ESD damage, check for " lightup " and Vf of the suspect LEDs at low currents.
The Vf of " good " LEDs should be >2.0V@0.1mA for InGaN product

## 7. Reliability Test

| No | Items | Temperature (℃) | Humidity (%) | Other condition | Hrs | Times | Sampling | Criteria for judgment | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | LED brightness @ 20mA | Vf @ 20mA |
| 1 | High temperature storage | 100 | | ----- | 1000 | | 30 | >70% | <110% |
| 2 | Temperature humidity storage | 60 | 90 | ----- | 1000 | | 30 | >70% | <110% |
| 3 | Low temp Storage | -40 | | ----- | 1000 | | 30 | >70% | <110% |
| 4 | Steady State Operating Life Condition 1 | 25 | | IF =20mA | 1000 | | 30 | >70% | <110% |
| 5 | Steady State Operating Life Condition 2 | 25 | | IF =30mA | 500 | | 30 | >70% | <110% |
| 6 | Steady State Operating Life of High Temperature | 85 | | IF =20mA | 500 | | 30 | >70% | <110% |
| 7 | Steady State Operating Life of High Humidity Heat | 60 | 90 | IF =20mA | 500 | | 30 | >70% | <110% |
| 8 | Steady State Operating Life of Low Temperature | -30 | | IF =20mA | 1000 | | 30 | >70% | <110% |
| 9 | On/Off testing | 60 | Room Humidity | IF =20mA<br>10secON /10secOFF 35000 circular Continue | 195 | | 30 | >50% | <110% |
| 10 | Thermal Shock | ------ | ------ | -30℃ ~ 85℃ 0.5hr. 0.5hr | | 200 cycles | 30 | >70% | <110% |
| 11 | Thermal Cycle | [1] | [1] | [1] | 152 hours/2 cycles | 1 | 30 | >70% | <110% |
| 12 | Resistance to Soldering Heat (Reflow Soldering) | | | TSld = 260℃, 10sec. | | 2 | 30 | < ±5% | < ±5% |
| 13 | Vibration[3] | Room Temp | Room Humidity | Random, 1.5Grms, 10~200Hz, for 30 min changeable vibration per circular X,Y,Z 3 directions | 30 min /time | 1 | 30 | Go or not Go | |

[1] The thermal profile is shown below




## 8. Estimated Life time

| Item | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Life time(*1) | Ta=60℃ IF=20mA Tj≦70℃(*2) | 10000 | - | - | hrs |

(*1)Life time means that estimated time to 50% degradation of initial luminous intensity.

(*2)Using testing circuit board:

Test board dimension: 25x25x1 $mm^3$ (L x W x H)

Material: FR4

**9. Others**

The appearance and specifications of the product may be modified for improvement without prior notice.

**10. Suggested Checking List**

Training and Certification

1. Everyone working in a static-safe area is ESD-certified?
2. Training records kept and re-certification dates monitored?

Static-Safe Workstation & Work Areas

1. Static-safe workstation or work-areas have ESD signs?
2. All surfaces and objects at all static-safe workstation and within 1 ft measure less than 100V?
3. All ionizer activated, positioned towards the units?
4. Each work surface mats grounding is good?

Personnel Grounding

1. Every person (including visitors) handling ESD sensitive (ESDS) items wear wrist strap, heel strap or conductive shoes with conductive flooring?
2. If conductive footwear used, conductive flooring also present where operator stand or walk?
3. Garments, hairs or anything closer than 1 ft to ESD items measure less than 100V*?
4. Every wrist strap or heel strap/conductive shoes checked daily and result recorded for all DLs?
5. All wrist strap or heel strap checkers calibration up to date?

   Note: *50V for Blue LED.

Device Handling

1. Every ESDS items identified by EIA-471 labels on item or packaging?
2. All ESDS items completely inside properly closed static-shielding containers when not at static-safe workstation?
3. No static charge generators (e.g. plastics) inside shielding containers with ESDS items?
4. All flexible conductive and dissipative package materials inspected before reuse or recycle?

Others

1. Audit result reported to entity ESD control coordinator?
2. Corrective action from previous audits completed?
3. Are audit records complete and on file?