# ALMD-EL3E, ALMD-EG3E, ALMD-CM3E, ALMD-CB3E

High Brightness SMT Round

Red, Amber, Green and Blue LED Lamps

## Data Sheet

Lead (Pb) Free
RoHS 6 fully compliant

### Description

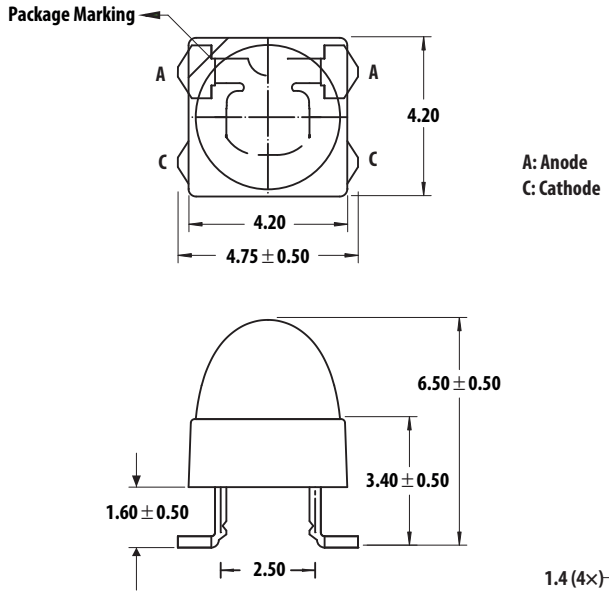
The new Avago ALMD-xx3E LED series has the same or just slightly less luminous intensity than conventional high brightness, through-hole LEDs.

The new LED lamps can be assembled using common SMT assembly processes and are compatible with industrial reflow soldering processes.

The LEDs are made with an advanced optical grade epoxy for superior performance in outdoor sign applications.

For easy pick and place assembly, the LEDs are shipped in tape and reel. Every reel is shipped from a single intensity and color bin– except the red color–for better uniformity.

### Package Dimensions




### Features

- Compact form factor
- High brightness material
- Available in Red, Amber, Green and Blue color
- Red AlInGaP 626 nm
- Amber AlInGaP 590 nm
- Green InGaN 525 nm
- Blue InGaN 470 nm
- JEDEC MSL 2A
- Compatible with reflow soldering process
- Tinted lens
- Typical viewing angle: 30°

### Applications

- Full color signs
- Mono color signs

Notes:
1. All dimensions in millimeters (inches).
2. Tolerance is ± 0.20 mm, unless otherwise specified.
3. Mildsteel leadframe.

***CAUTION:*** *InGaN devices are Class 1C HBM ESD sensitive, AlInGaP devices are Class 1B ESD sensitive per JEDEC Standard. Please observe appropriate precautions during handling and processing. Refer to Application Note AN-1142 for additional details.*

***CAUTION:*** *Customer is advised to always keep the LED in the MBB with <5% RH when not in use as prolonged exposure to environment might cause the silver-plated leads to tarnish or rust, which might cause difficulties in soldering.*

## Device Selection Guide

| Part Number | Color and Dominant Wavelength $\lambda_d$ (nm) Typ. [3] | Luminous Intensity Iv (mcd) [1,2,5] | | Viewing Angle Typ. (°) [4] |
|---|---|---|---|---|
| | | Min. | Max. | |
| ALMD-EG3E-VX002 | Red 626 | 4200 | 9300 | 30° |
| ALMD-EL3E-VX002 | Amber 590 | 4200 | 9300 | |
| ALMD-CM3E-Y1002 | Green 525 | 9300 | 21000 | |
| ALMD-CB3E-SU002 | Blue 470 | 1900 | 4200 | |

Notes:
1. The luminous intensity is measured on the mechanical axis of the lamp package and it is tested with pulsing condition.
2. The optical axis is closely aligned with the package mechanical axis.
3. Dominant wavelength, $\lambda_d$, is derived from the CIE Chromaticity Diagram and represents the color of the lamp.
4. $\theta_{1/2}$ is the off-axis angle where the luminous intensity is half the on-axis intensity.
5. Tolerance for each bin limit is ± 15%.

## Part Numbering System

A L M D - x1 x2 x3 x4 - x5 x6 x7 x8 x9

| Code | Description | Option | |
|---|---|---|---|
| x1 | Package type | E | Round AlInGaP |
| | | C | Round InGaN |
| x2 | Color | B | Blue |
| | | G | Red |
| | | L | Amber |
| | | M | Green |
| x3 | Viewing angle | 3 | 30° |
| x4 | Product specific designation | E | |
| x5 | Minimum intensity bin | Refer to device selection guide | |
| x6 | Maximum intensity bin | Refer to device selection guide | |
| x7 | Color bin selection | 0 | Full distribution |
| x8x9 | Packaging option | 02 | Tested 20mA, 13inch carrier tape |

## Absolute Maximum Rating, $T_J = 25\ °C$

| Parameter | Red and Amber | Green | Blue | Unit |
|---|---|---|---|---|
| DC Forward Current [1] | 50 | 30 | 20 | mA |
| Peak Forward Current | 100 [2] | 100 [3] | 100 [3] | mA |
| Power Dissipation | 120 | 114 | 76 | mW |
| LED Junction Temperature | | 110 | | °C |
| Operating Temperature Range | | -40 to +85 | | °C |
| Storage Temperature Range | | -40 to +100 | | °C |

Notes:
1. Derate linearly as shown in Figure 4 and Figure 9.
2. Duty Factor 30%, frequency 1 kHz.
3. Duty Factor 10%, frequency 1 kHz.

## Electrical / Optical Characteristics, $T_J = 25\ °C$

| Parameter | Symbol | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| Forward Voltage | $V_F$ | | | | V | $I_F$ = 20 mA |
| Red | | 1.8 | 2.1 | 2.4 | | |
| Amber | | 1.8 | 2.1 | 2.4 | | |
| Green | | 2.8 | 3.2 | 3.8 | | |
| Blue | | 2.8 | 3.2 | 3.8 | | |
| Reverse Voltage [3] | $V_R$ | | | | | |
| Red & Amber | | 5 | | | V | $I_R$ = 100 µA |
| Green & Blue | | 5 | | | | $I_R$ = 10 µA |
| Dominant Wavelength [1] | $\lambda_d$ | | | | | $I_F$ = 20 mA |
| Red | | 618.0 | 626.0 | 630.0 | | |
| Amber | | 584.5 | 590.0 | 594.5 | | |
| Green | | 519.0 | 525.0 | 539.0 | | |
| Blue | | 460.0 | 470.0 | 480.0 | | |
| Peak Wavelength | $\lambda_{PEAK}$ | | | | nm | Peak of Wavelength of Spectral |
| Red | | | 634 | | | Distribution at $I_F$ = 20 mA |
| Amber | | | 594 | | | |
| Green | | | 516 | | | |
| Blue | | | 464 | | | |
| Thermal Resistance | $R\theta_{J\text{-}PIN}$ | | | | °C/W | LED Junction-to-Pin |
| Red | | | 270 | | | |
| Amber | | | 270 | | | |
| Green | | | 270 | | | |
| Blue | | | 480 | | | |
| Luminous Efficacy [2] | $\eta_V$ | | | | lm/W | Emitted Luminous Power/Emitted |
| Red | | | 200 | | | Radiant Power |
| Amber | | | 490 | | | |
| Green | | | 530 | | | |
| Blue | | | 65 | | | |
| Thermal coefficient of $\lambda_d$ | | | | | nm/°C | $I_F$ = 20 mA ; +25 °C ≤ $T_J$ ≤ +100 °C |
| Red | | | 0.059 | | | |
| Amber | | | 0.103 | | | |
| Green | | | 0.028 | | | |
| Blue | | | 0.024 | | | |

Notes:
1. The dominant wavelength is derived from the chromaticity diagram and represents the color of the lamp.
2. The radiant intensity, $I_e$ in watts per steradian, may be found from the equation $I_e = I_V/\eta_V$ where $I_V$ is the luminous intensity in candelas and $\eta_V$ is the luminous efficacy in lumens/watt.
3. Indicates product final testing condition. Long-term reverse bias is not recommended.

## AlInGaP

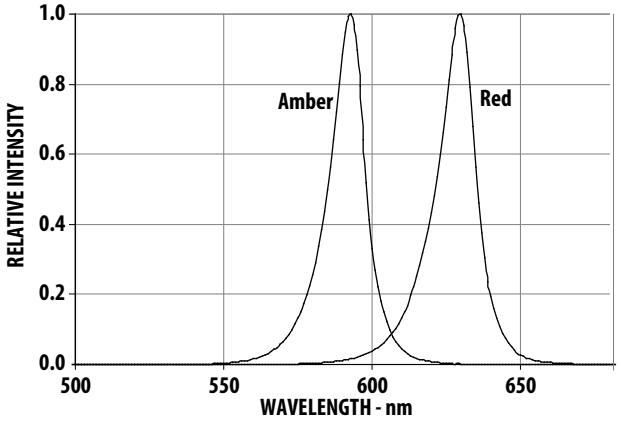



Figure 1. Relative Intensity vs. Wavelength

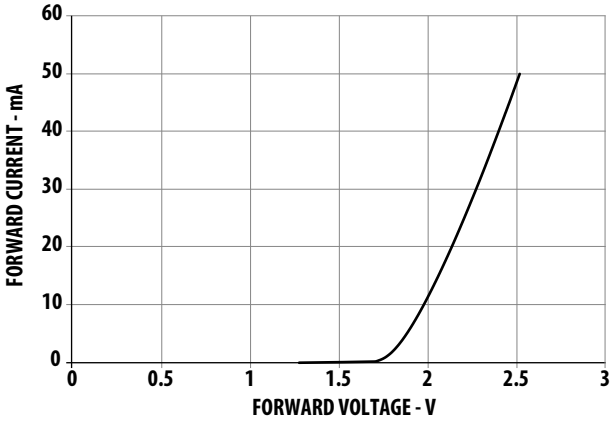



Figure 2. Forward Current vs. Forward Voltage

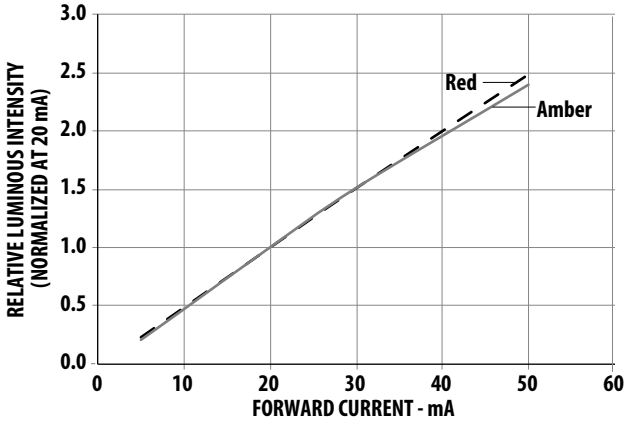



Figure 3. Relative Intensity vs. Forward Current

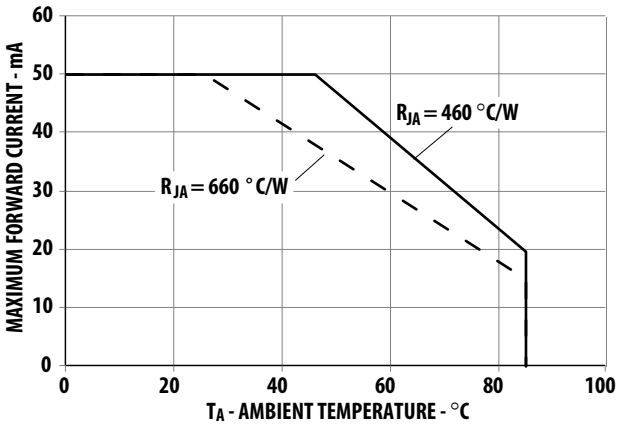



Figure 4. Maximum Forward Current vs. Ambient Temperature

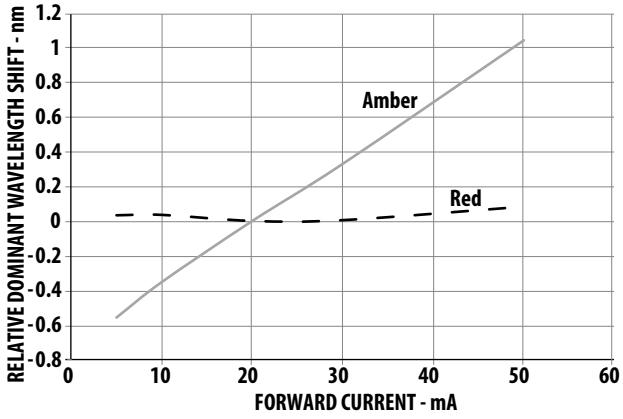



Figure 5. Relative Dominant Wavelength Shift vs. Forward Current

## InGaN

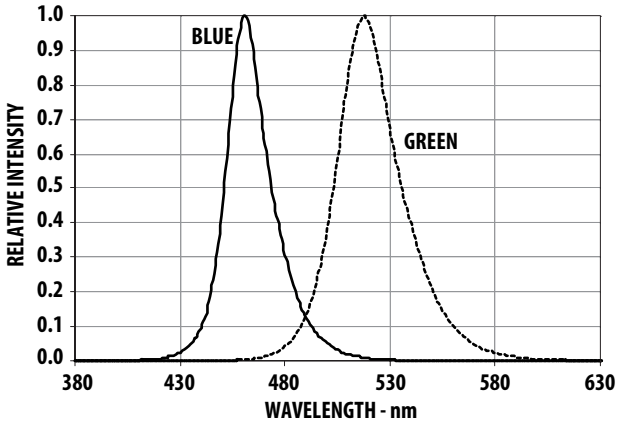



Figure 6. Relative Intensity vs. Wavelength

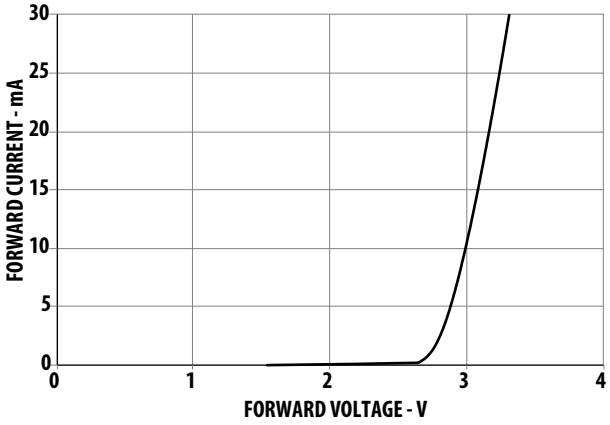



Figure 7. Forward Current vs. Forward Voltage

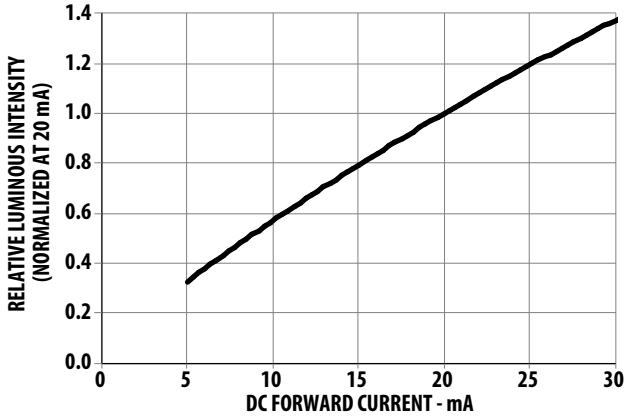



Figure 8. Relative Intensity vs. Forward Current

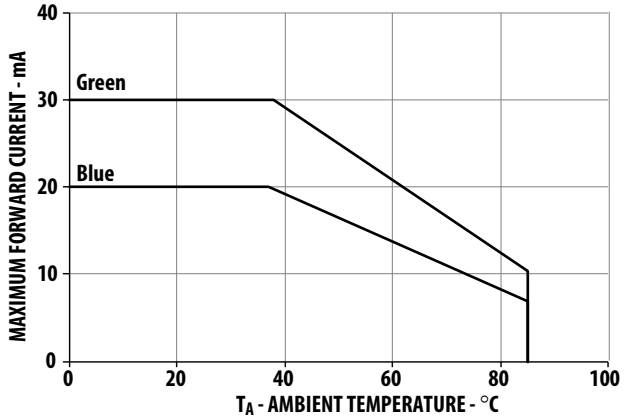



Figure 9. Maximum Forward Current vs. Ambient Temperature

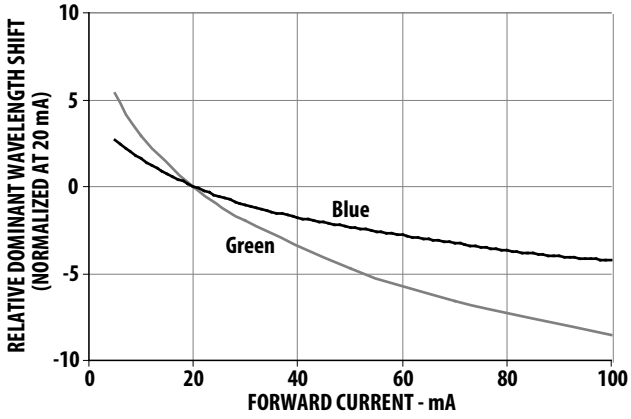



Figure 10. Dominant Wavelength Shift vs. Forward Current

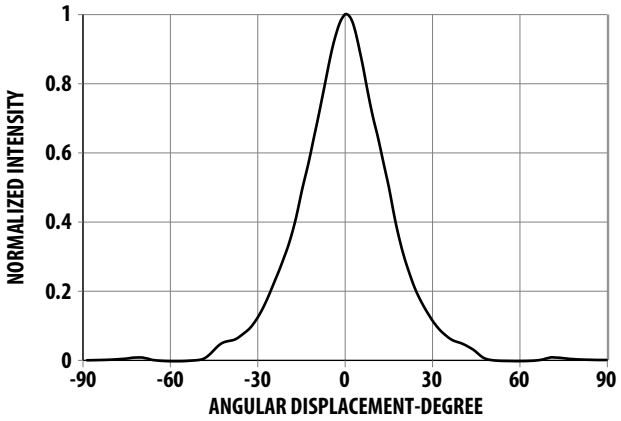



Figure 11a. Radiation Pattern for x-axis

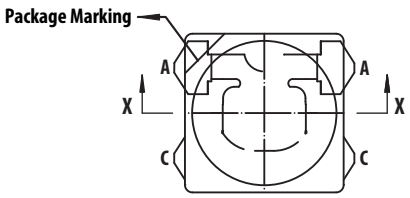



Figure 11b. Component Axis for Radiation Pattern

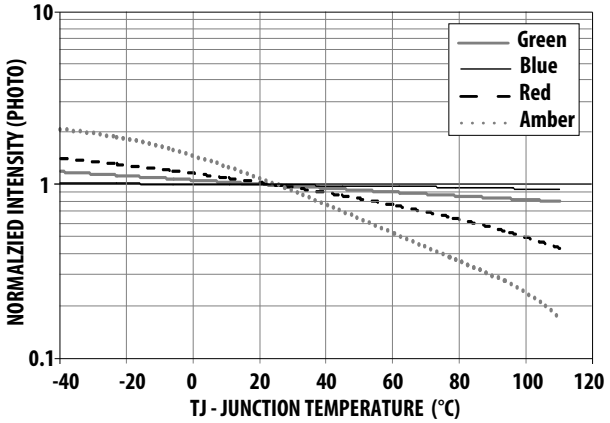



Figure 12. Relative Intensity Shift vs. Junction Temperature

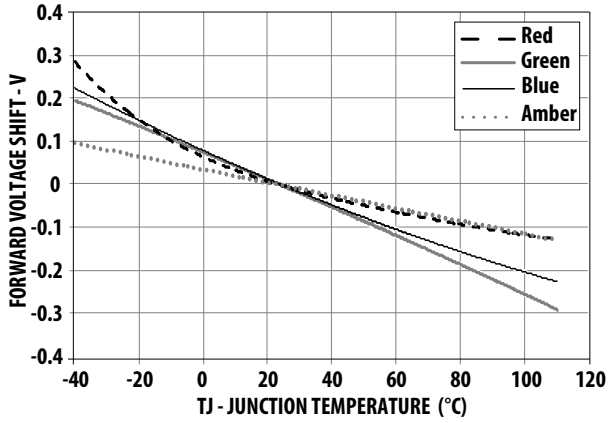
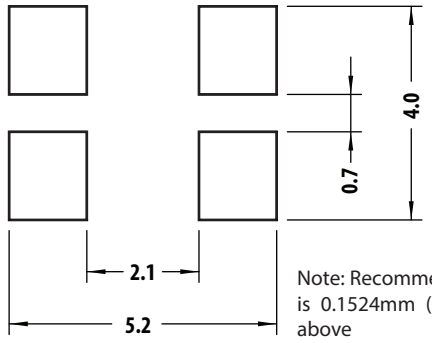



Figure 13. Forward Voltage Shift vs. Junction Temperature




Note: Recommended stencil thickness is 0.1524mm (6 mils) minimum and above

Figure 14. Recommended Soldering Land Pattern

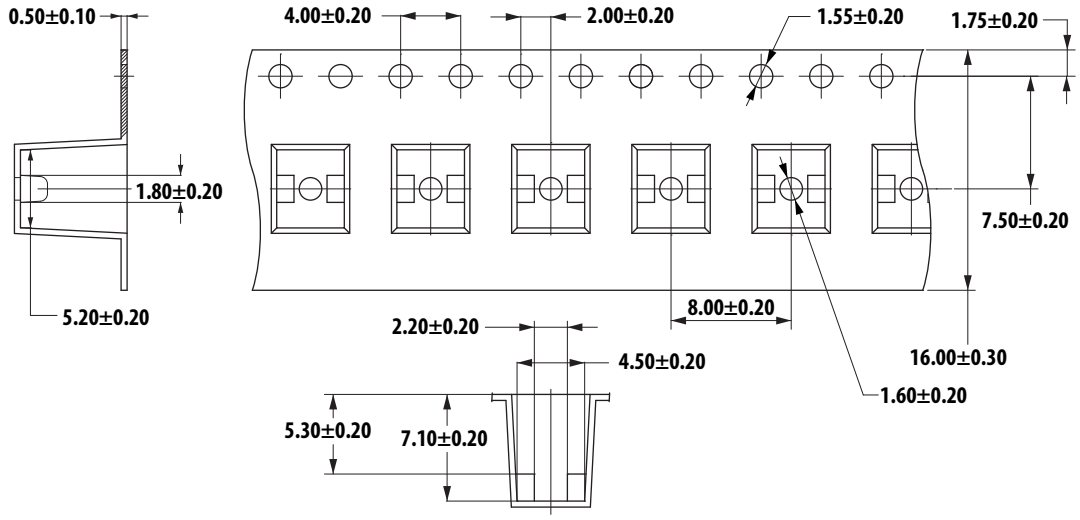



**Figure 15. Carrier Tape Dimension**

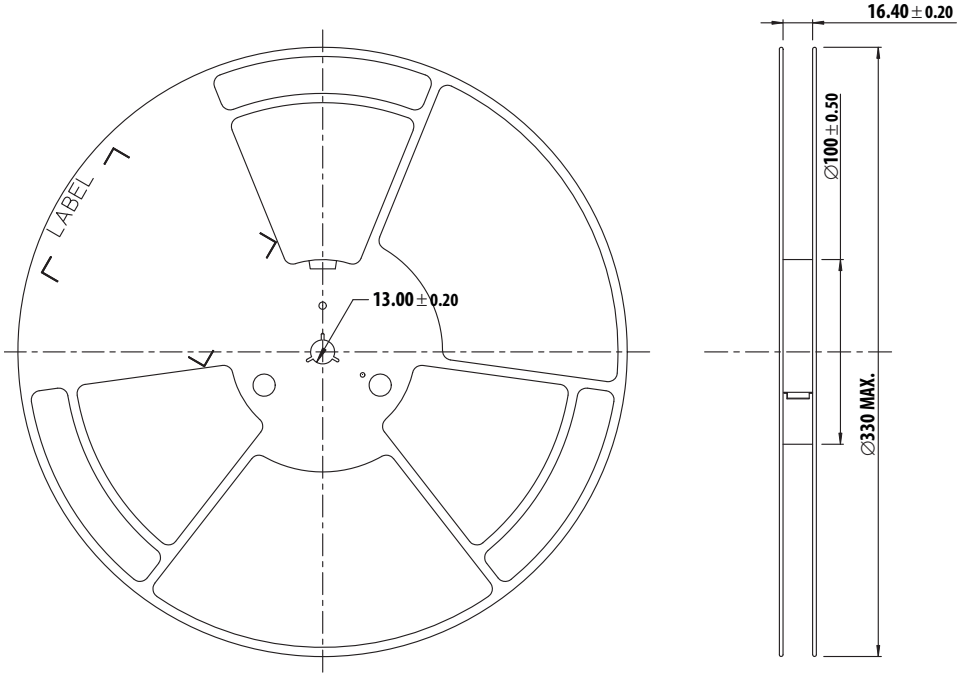



**Figure 16. Reel Dimension**

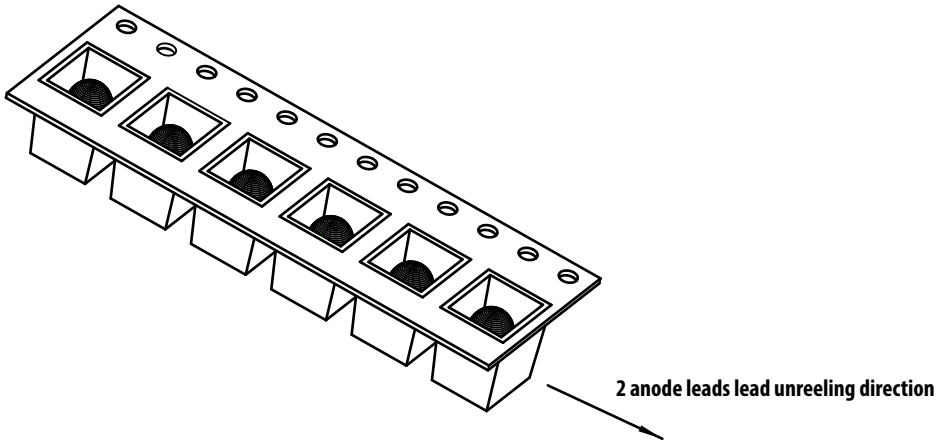



**Figure 17. Unit Orientation from reel**

### Intensity Bin Limit Table (1.3:1 Iv bin ratio)

| | Intensity (mcd) at 20 mA | |
|---|---|---|
| **Bin** | **Min.** | **Max.** |
| S | 1900 | 2500 |
| T | 2500 | 3200 |
| U | 3200 | 4200 |
| V | 4200 | 5500 |
| W | 5500 | 7200 |
| X | 7200 | 9300 |
| Y | 9300 | 12000 |
| Z | 12000 | 16000 |
| 1 | 16000 | 21000 |

Tolerance for each bin limit is ± 15%

### $V_F$ Bin Table (V at 20 mA) for Red and Amber only

| Bin ID | Min. | Max. |
|---|---|---|
| $V_D$ | 1.8 | 2.0 |
| $V_A$ | 2.0 | 2.2 |
| $V_B$ | 2.2 | 2.4 |

Tolerance for each bin limit is ± 0.05 V

### Red Color Range

| Min Dom | Max Dom | X min | Y Min | X max | Y max |
|---|---|---|---|---|---|
| 618.0 | 630.0 | 0.6872 | 0.3126 | 0.6890 | 0.2943 |
| | | 0.6690 | 0.3149 | 0.7080 | 0.2920 |

Tolerance for each bin limit is ± 0.5nm

### Amber Color Range

| Bin | Min Dom | Max Dom | Xmin | Ymin | Xmax | Ymax |
|---|---|---|---|---|---|---|
| 1 | 584.5 | 587.0 | 0.5420 | 0.4580 | 0.5530 | 0.4400 |
| | | | 0.5370 | 0.4550 | 0.5570 | 0.4420 |
| 2 | 587.0 | 589.5 | 0.5570 | 0.4420 | 0.5670 | 0.4250 |
| | | | 0.5530 | 0.4400 | 0.5720 | 0.4270 |
| 4 | 589.5 | 592.0 | 0.5720 | 0.4270 | 0.5820 | 0.4110 |
| | | | 0.5670 | 0.4250 | 0.5870 | 0.4130 |
| 6 | 592.0 | 594.5 | 0.5870 | 0.4130 | 0.5950 | 0.3980 |
| | | | 0.5820 | 0.4110 | 0.6000 | 0.3990 |

Tolerance for each bin limit is ± 0.5nm

### Green Color Range

| Bin | Min Dom | Max Dom | Xmin | Ymin | Xmax | Ymax |
|---|---|---|---|---|---|---|
| 1 | 519.0 | 523.0 | 0.0667 | 0.8323 | 0.1450 | 0.7319 |
| | | | 0.1200 | 0.7375 | 0.0979 | 0.8316 |
| 2 | 523.0 | 527.0 | 0.0979 | 0.8316 | 0.1711 | 0.7218 |
| | | | 0.1450 | 0.7319 | 0.1305 | 0.8189 |
| 3 | 527.0 | 531.0 | 0.1305 | 0.8189 | 0.1967 | 0.7077 |
| | | | 0.1711 | 0.7218 | 0.1625 | 0.8012 |
| 4 | 531.0 | 535.0 | 0.1625 | 0.8012 | 0.2210 | 0.6920 |
| | | | 0.1967 | 0.7077 | 0.1929 | 0.7816 |
| 5 | 535.0 | 539.0 | 0.1929 | 0.7816 | 0.2445 | 0.6747 |
| | | | 0.2210 | 0.6920 | 0.2233 | 0.7600 |

Tolerance for each bin limit is ± 0.5nm

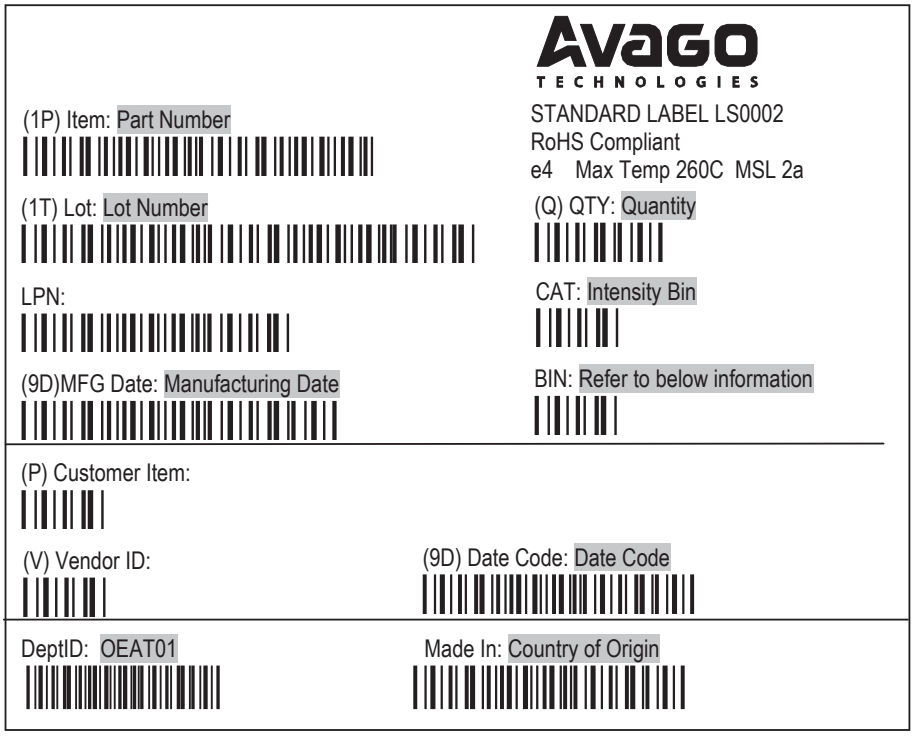
### Blue Color Range

| Bin | Min Dom | Max Dom | Xmin | Ymin | Xmax | Ymax |
|---|---|---|---|---|---|---|
| 1 | 460.0 | 464.0 | 0.1440 | 0.0297 | 0.1766 | 0.0966 |
| | | | 0.1818 | 0.0904 | 0.1374 | 0.0374 |
| 2 | 464.0 | 468.0 | 0.1374 | 0.0374 | 0.1699 | 0.1062 |
| | | | 0.1766 | 0.0966 | 0.1291 | 0.0495 |
| 3 | 468.0 | 472.0 | 0.1291 | 0.0495 | 0.1616 | 0.1209 |
| | | | 0.1699 | 0.1062 | 0.1187 | 0.0671 |
| 4 | 472.0 | 476.0 | 0.1187 | 0.0671 | 0.1517 | 0.1423 |
| | | | 0.1616 | 0.1209 | 0.1063 | 0.0945 |
| 5 | 476.0 | 480.0 | 0.1063 | 0.0945 | 0.1397 | 0.1728 |
| | | | 0.1517 | 0.1423 | 0.0913 | 0.1327 |

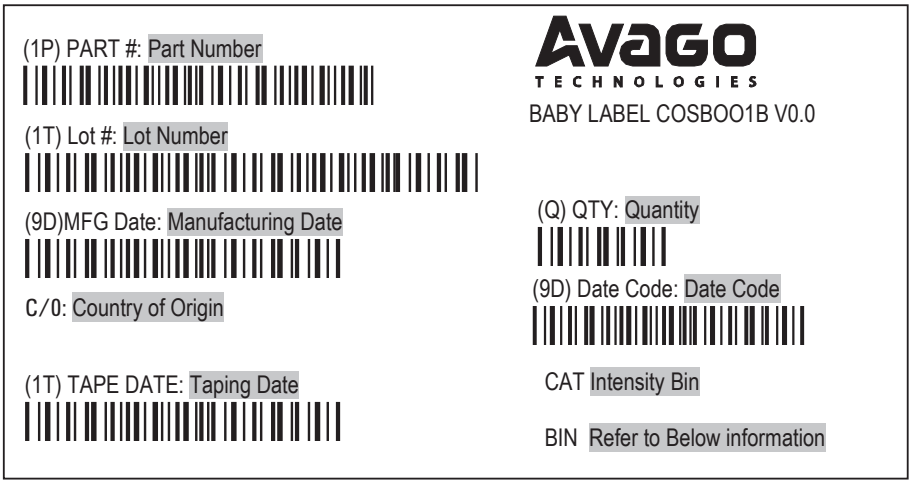
Tolerance for each bin limit is ± 0.5nm

## Packing Label

(i) Mother Label (Available on MBB bag)




(ii) Baby Label (Available on Plastic Reel)




Note: Acronyms and Definition:

BIN:

**(i) Color bin only or $V_F$ bin only**

(Applicable for part number with color bins but without $V_F$ bin *or* part number with $V_F$ bins and no color bin)

**(ii) Color bin incorporated with $V_F$ bin**

Applicable for part number that have both color bin and $V_F$ bin

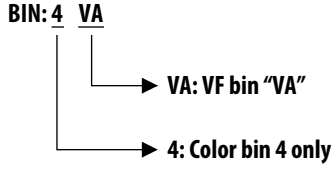
Example:

a. Color bin only or $V_F$ bin only

BIN: 4 (represent color bin 4 only)

BIN: $V_A$ (represent $V_F$ bin "$V_A$" only)

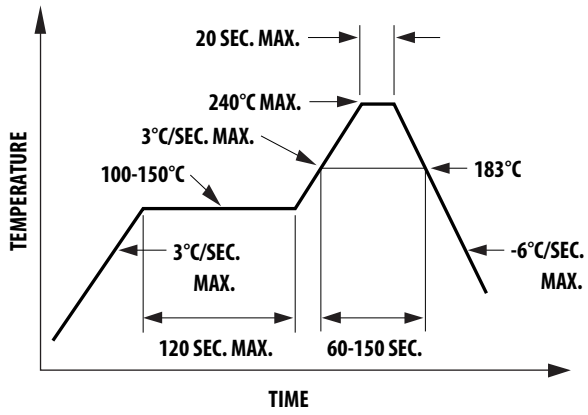
b. Color bin incorporate with $V_F$ bin



## Soldering

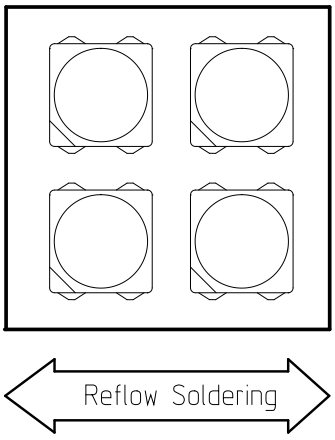
Recommended reflow soldering condition:

**(i) Leaded reflow soldering:**

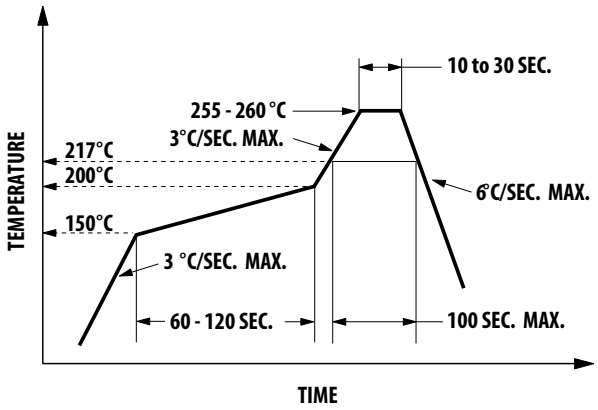



a. Reflow soldering must not be done more than two times. Do observe necessary precautions for handling a moisture-sensitive device, as stated in the following section.

b. Recommended board reflow direction:




**(ii) Lead-free reflow soldering:**




c. Do not apply any pressure or force on the LED during reflow and after reflow when the LED is still hot.

d. It is preferred that you use reflow soldering to solder the LED. Use hand soldering only for rework if unavoidable but must be strictly controlled to the following conditions:

- Soldering iron tip temperature = 320 °C max.
- Soldering duration = 3 sec max.
- Number of cycles = 1 only
- Power of soldering iron = 50 W max.

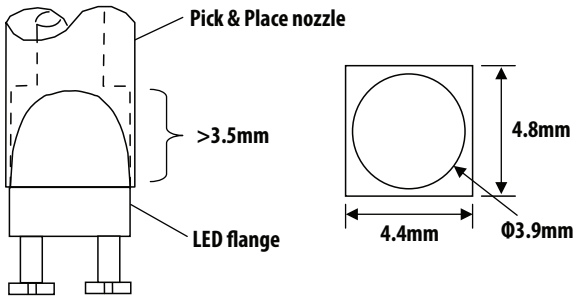
e. Do not touch the LED body with a hot soldering iron except the soldering terminals as this may damage the LED.

f. For de-soldering, it is recommended to use appropriate double head soldering iron. User is advised to confirm beforehand whether the functionality and performance of the LED is affected by hand soldering.

## PRECAUTIONARY NOTES

### 1. Handling precautions

For automated pick and place, Avago has tested nozzle size below made with urethane material to be working fine with this LED. However, due to the possibility of variations in other parameters such as pick and place machine maker/model and other settings of the machine, customer is recommended to verify the nozzle selected.




Note:
1. Nozzle tip should touch the LED flange during pick and place.
2. Outer dimensions of the nozzle should be able to fit into the carrier tape pocket.

### 2. Handling of moisture-sensitive device

This product has a Moisture Sensitive Level 2a rating per JEDEC J-STD-020. Refer to Avago Application Note AN5305, Handling of Moisture Sensitive Surface Mount Devices, for additional details and a review of proper handling procedures.

a. Before use
   - An unopened moisture barrier bag (MBB) can be stored at <40°C/90%RH for 12 months. If the actual shelf life has exceeded 12 months and the humidity Indicator Card (HIC) indicates that baking is not required, then it is safe to reflow the LEDs per the original MSL rating.
   - It is recommended that the MBB not be opened prior to assembly (e.g. for IQC).

b. Control after opening the MBB
   - The humidity indicator card (HIC) shall be read immediately upon opening of MBB.
   - The LEDs must be kept at <30°C / 60%RH at all times and all high temperature related processes including soldering, curing or rework need to be completed within 672 hours.

c. Control for unfinished reel
   - Unused LEDs must be stored in a sealed MBB with desiccant or desiccator at <5%RH.

d. Control of assembled boards
   - If the PCB soldered with the LEDs is to be subjected to other high temperature processes, the PCB need to be stored in sealed MBB with desiccant or desiccator at <5%RH to ensure that all LEDs have not exceeded their floor life of 672 hours.

e. Baking is required if:
   - The HIC indicator is not BROWN at 10% and is AZURE at 5%.
   - The LEDs are exposed to condition of >30°C / 60% RH at any time.
   - The LED floor life exceeded 672hrs.

   The recommended baking condition is: 60±5°C for 20hrs. Baking should only be done once.

f. Storage
   - The soldering terminals of these Avago LEDs are silver plated. If the LEDs are being exposed in ambient environment for too long, the silver plating might be oxidized and thus affecting its solderability performance. As such, unused LEDs must be kept in sealed MBB with desiccant or in desiccator at <5%RH.

### 3. Application precautions

a. Drive current of the LED must not exceed the maximum allowable limit across temperature as stated in the datasheet. Constant current driving is recommended to ensure consistent performance.

b. LED is not intended for reverse bias. Do use other appropriate components for such purpose. When driving the LED in matrix form, it is crucial to ensure that the reverse bias voltage is not exceeding the allowable limit of the LED.

c. Avoid rapid change in ambient temperature especially in high humidity environment as this will cause condensation on the LED.

d. If the LED is intended to be used in outdoor or harsh environment, the LED leads must be protected with suitable potting material against damages caused by rain water, oil, corrosive gases etc. It is recommended to have louver or shade to reduce direct sunlight on the LEDs.

### 4. Eye safety precautions

LEDs may pose optical hazards when in operation. It is not advisable to view directly at operating LEDs as it may be harmful to the eyes. For safety reasons, use appropriate shielding or personal protective equipments.

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