

# HLMP-LG71, HLMP-LM71, HLMP-LB71

Red, Green and Blue

4 mm Standard Oval LEDs



## Data Sheet



### Description

These Precision Optical Performance Oval LEDs are specifically designed for full color/video and passenger information signs. The oval shaped radiation pattern and high luminous intensity ensure that these devices are excellent for wide field of view outdoor applications where a wide viewing angle and readability in sunlight are essential. The package epoxy contains UV inhibitors to reduce the effects of long term exposure to direct sunlight.

### Applications

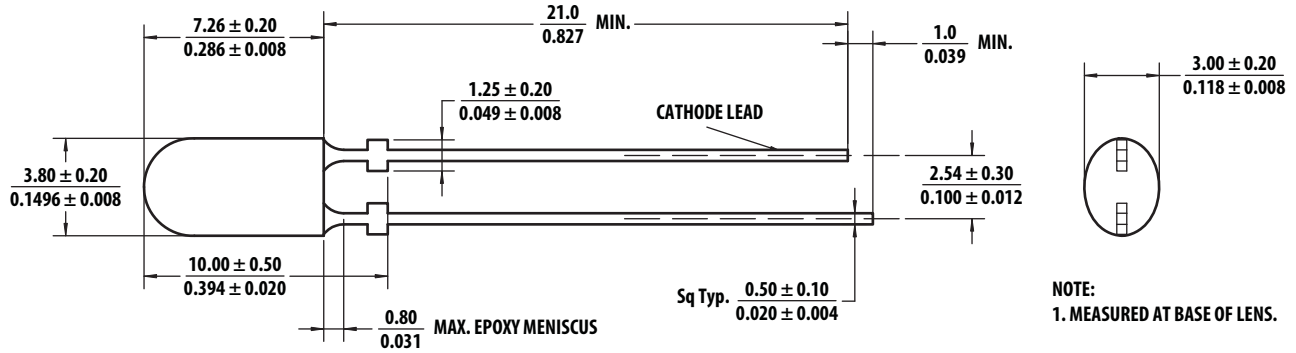
- Billboard signs
- Full color signs

### Features

- Well defined spatial radiation pattern
- High brightness material
- Available in red, green and blue color.
  - Red AlInGaP 626 nm
  - Green InGaN 525 nm
  - Blue InGaN 470 nm
- Superior resistance to moisture
- Standoff Package
- Tinted and diffused
- Typical viewing angle 40° x 100°

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

## Package Dimensions



Notes:

All dimensions in millimeters (inches).

Tolerance is  $\pm 0.20$  mm unless other specified

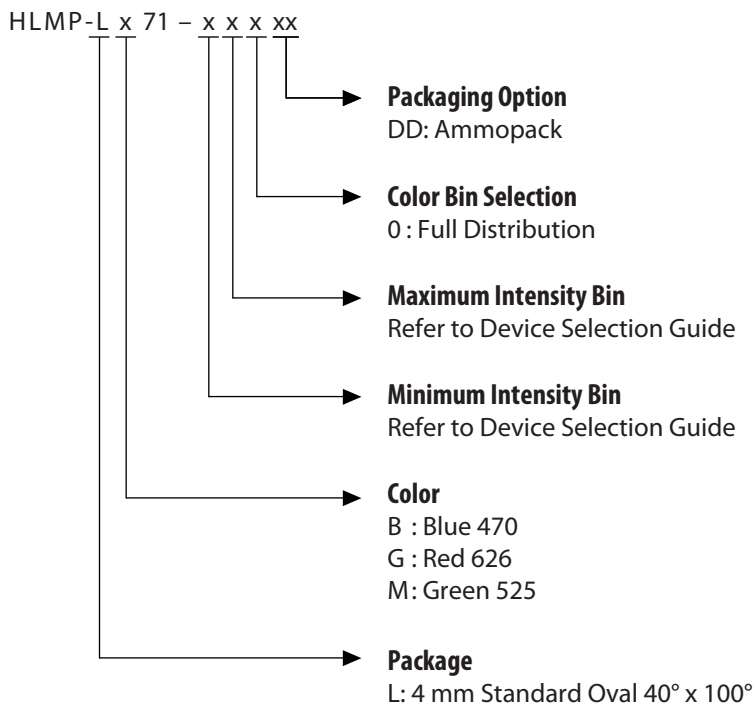
## Device Selection Guide

| Part Number     | Color and Dominant Wavelength $\lambda_d$ (nm) Typ <sup>[3]</sup> | Luminous Intensity $I_v$ (mcd) at 20 mA <sup>[1,2,4]</sup> | Luminous Intensity $I_v$ (mcd) at 20 mA <sup>[1,2,4]</sup> |
|-----------------|---|--|--|
| HLMP-LG71-VY0DD | Red 626   | 1150   | 2400   |
| HLMP-LM71-Z30DD | Green 525   | 2400   | 5040   |
| HLMP-LB71-SV0DD | Blue 470  | 660  | 1380   |

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. Tolerance for each bin limit is  $\pm 15\%$ .

## Part Numbering System



Note: Please refer to AB 5337 for complete information about part numbering system.

## Absolute Maximum Ratings

$T_A = 25^\circ\text{C}$

| Parameter                         | Red                | Green/ Blue        | Unit |
|-----------------------------------|--------------------|--------------------|------|
| DC Forward Current <sup>[1]</sup> | 50                 | 30                 | mA   |
| Peak Forward Current              | 100 <sup>[2]</sup> | 100 <sup>[3]</sup> | mA   |
| Power Dissipation                 | 120                | 110                | mW   |
| LED Junction Temperature          | 130                | 110                | °C   |
| Operating Temperature Range       | -40 to +100        | -40 to +85         | °C   |
| Storage Temperature Range         |                    | -40 to +100        | °C   |

Notes:

1. Derate linearly as shown in Figures 4 and 8.
2. Duty Factor 30%, frequency 1 kHz.
3. Duty Factor 10%, frequency 1 kHz.

## Electrical / Optical Characteristics

$T_A = 25^\circ\text{C}$

| Parameter                          | Symbol                   | Min. | Typ. | Max. | Units | Test Conditions   |
|------------------------------------|--------------------------|------|------|------|-------|---|
| Forward Voltage                    | $V_F$                    |      |      |      | V     | $I_F = 20\text{ mA}$  |
| Red                                |                          | 1.8  | 2.1  | 2.4  |       |   |
| Green                              |                          | 2.8  | 3.1  | 3.6  |       |   |
| Blue                               |                          | 2.8  | 3.1  | 3.6  |       |   |
| Reverse Voltage <sup>[1]</sup>     | $V_R$                    |      |      |      | V     |   |
| Red                                |                          | 5    |      |      |       | $I_R = 100\ \mu\text{A}$  |
| Green and Blue                     |                          | 5    |      |      |       | $I_R = 10\ \mu\text{A}$   |
| Dominant Wavelength <sup>[2]</sup> |                          |      |      |      | nm    | $I_F = 20\text{ mA}$  |
| Red                                |                          | 618  | 626  | 630  |       |   |
| Green                              |                          | 520  | 525  | 540  |       |   |
| Blue                               |                          | 460  | 470  | 480  |       |   |
| Peak Wavelength                    | $\lambda_{\text{PEAK}}$  |      |      |      | nm    | Peak of Wavelength of Spectral Distribution at $I_F = 20\text{ mA}$ |
| Red                                |                          |      | 634  |      |       |   |
| Green                              |                          |      | 517  |      |       |   |
| Blue                               |                          |      | 461  |      |       |   |
| Thermal Resistance                 | $R\theta_{\text{J-PIN}}$ |      | 240  |      | °C/W  | LED Junction-to-Pin   |
| Luminous Efficacy <sup>[3]</sup>   | $\eta_V$                 |      |      |      | lm/W  | Emitted Luminous Power/<br>Emitted Radiant Power                    |
| Red                                |                          |      | 190  |      |       |   |
| Green                              |                          |      | 475  |      |       |   |
| Blue                               |                          |      | 68   |      |       |   |
| Luminous Efficiency <sup>[4]</sup> | $\eta_e$                 |      |      |      | lm/W  | Luminous Flux/Electrical Power                                      |
| Red                                |                          |      | 50   |      |       |   |
| Green                              |                          |      | 60   |      |       |   |
| Blue                               |                          |      | 13   |      |       |   |

Notes:

1. Indicates product final testing condition, long term reverse bias is not recommended.
2. The dominant wavelength is derived from the chromaticity Diagram and represents the color of the lamp.
3. 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.
4.  $\eta_e = \phi_V / I_F \times V_F$ , where  $\phi_V$  is the emitted luminous flux,  $I_F$  is electrical forward current and  $V_F$  is the forward voltage.

## AlInGaP Red

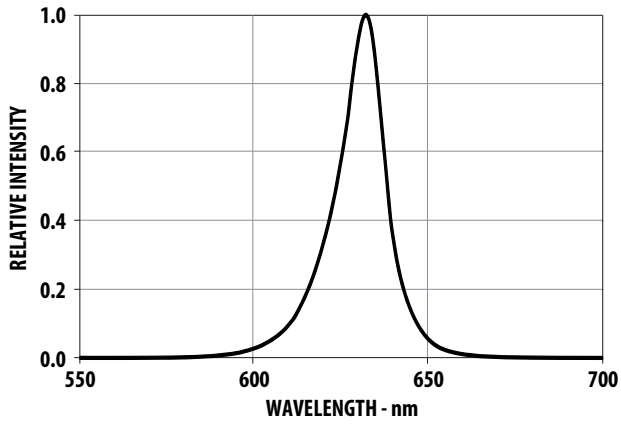


Figure 1. Relative Intensity vs Wavelength

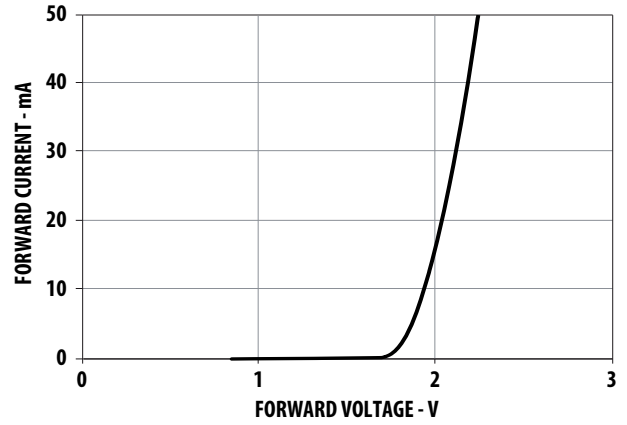


Figure 2. Forward Current vs Forward Voltage

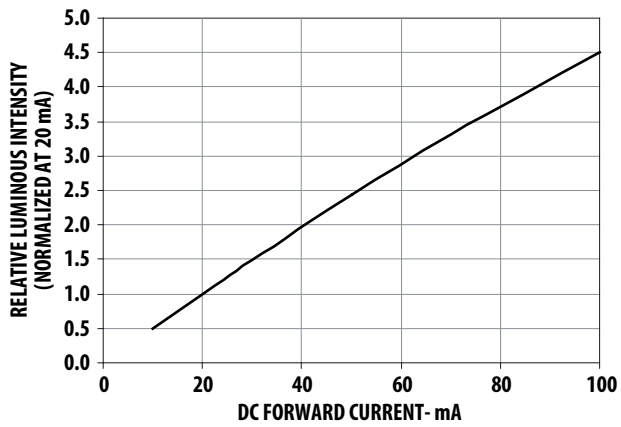


Figure 3. Relative Intensity vs Forward Current

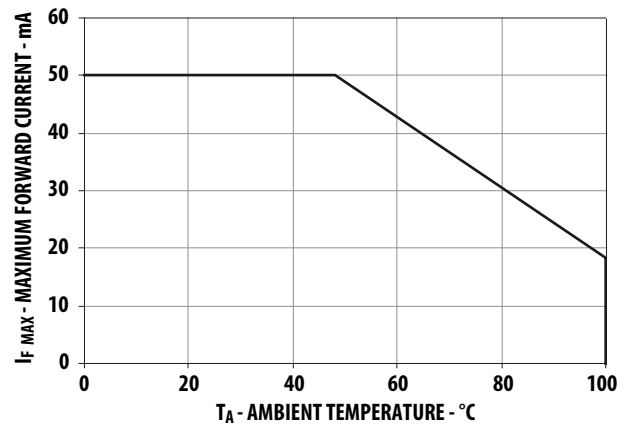


Figure 4. Maximum Forward Current vs Ambient Temperature

## InGaN Blue and Green

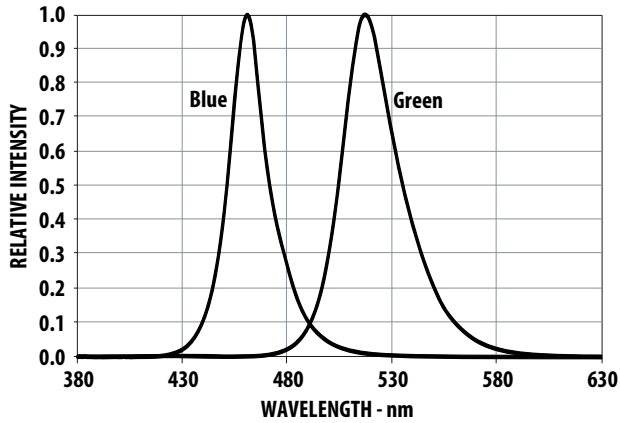


Figure 5. Relative Intensity vs Wavelength

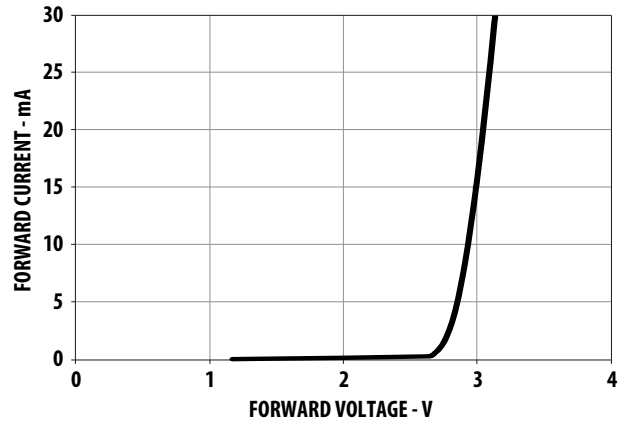


Figure 6. Forward Current vs Forward Voltage

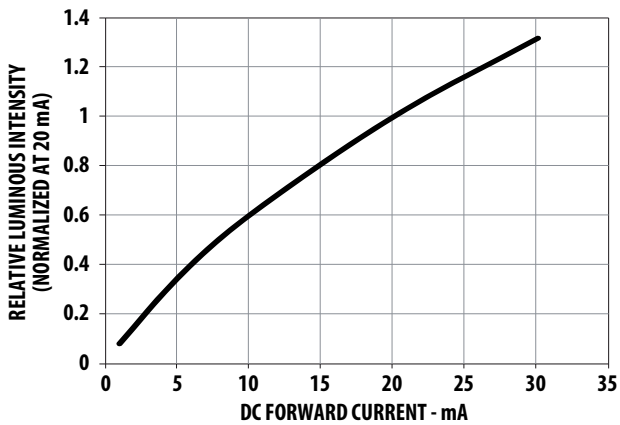


Figure 7. Relative Intensity vs Forward Current

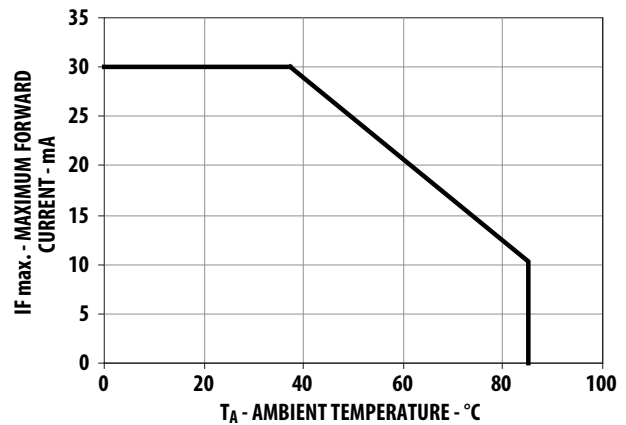


Figure 8. Maximum Forward Current vs Ambient Temperature

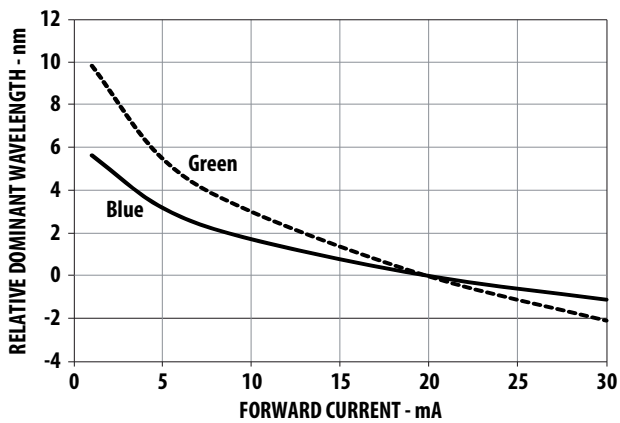


Figure 9. Relative dominant wavelength vs Forward Current

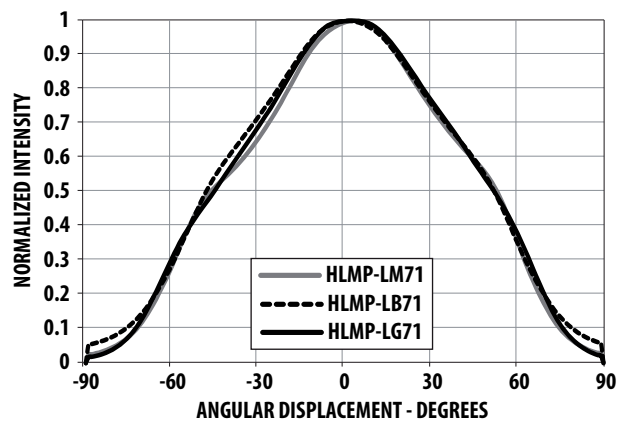


Figure 10. Radiation pattern-Major Axis

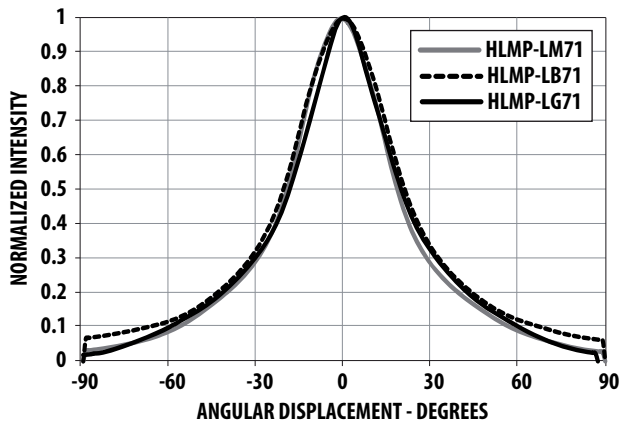


Figure 11. Radiation pattern-Minor Axis

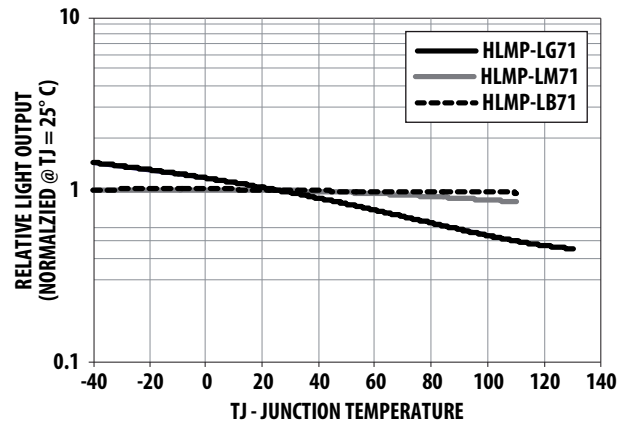


Figure 12. Relative Light Output vs Junction Temperature

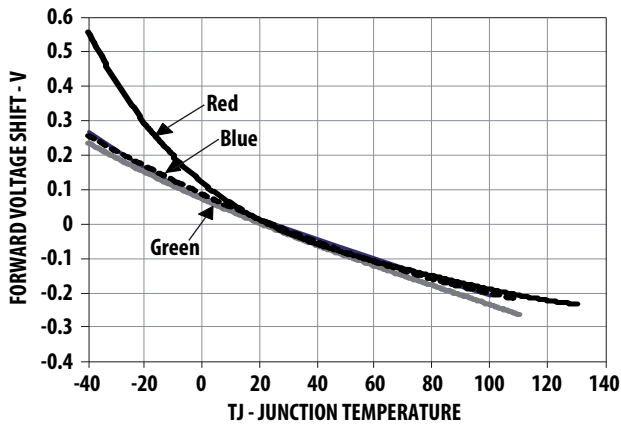


Figure 13. Forward Voltage Shift vs Junction Temperature

**Intensity Bin Limit Table (1.2: 1 Iv Bin Ratio)**

| Bin | Intensity (mcd) at 20 mA |      |
|-----|--------------------------|------|
|     | Min                      | Max  |
| S   | 660                      | 800  |
| T   | 800                      | 960  |
| U   | 960                      | 1150 |
| V   | 1150                     | 1380 |
| W   | 1380                     | 1660 |
| X   | 1660                     | 1990 |
| Y   | 1990                     | 2400 |
| Z   | 2400                     | 2900 |
| 1   | 2900                     | 3500 |
| 2   | 3500                     | 4200 |
| 3   | 4200                     | 5040 |

Tolerance for each bin limit is ±15%

**V<sub>F</sub> Bin Table (V at 20 mA)**

| Bin ID | Min | Max |
|--------|-----|-----|
| VD     | 1.8 | 2.0 |
| VA     | 2.0 | 2.2 |
| VB     | 2.2 | 2.4 |

Notes:

1. Tolerance for each bin limit is ±0.05 V
2. V<sub>F</sub> binning only applicable to Red color.

### Red Color Range

| Min Dom | Max Dom | Chromaticity Coordinate |        |        |        |        |
|---------|---------|-------------------------|--------|--------|--------|--------|
| 618.0   | 630.0   | x                       | 0.6872 | 0.3126 | 0.6890 | 0.2943 |
|         |         | y                       | 0.6690 | 0.3149 | 0.7080 | 0.2920 |

Tolerance for each bin limit is  $\pm 0.5$  nm

### Green Color Bin Table

| Bin | Min Dom | Max Dom | Xmin   | Ymin   | Xmax   | Ymax   |
|-----|---------|---------|--------|--------|--------|--------|
| 1   | 520.0   | 524.0   | 0.0743 | 0.8338 | 0.1856 | 0.6556 |
|     |         |         | 0.1650 | 0.6586 | 0.1060 | 0.8292 |
| 2   | 524.0   | 528.0   | 0.1060 | 0.8292 | 0.2068 | 0.6463 |
|     |         |         | 0.1856 | 0.6556 | 0.1387 | 0.8148 |
| 3   | 528.0   | 532.0   | 0.1387 | 0.8148 | 0.2273 | 0.6344 |
|     |         |         | 0.2068 | 0.6463 | 0.1702 | 0.7965 |
| 4   | 532.0   | 536.0   | 0.1702 | 0.7965 | 0.2469 | 0.6213 |
|     |         |         | 0.2273 | 0.6344 | 0.2003 | 0.7764 |
| 5   | 536.0   | 540.0   | 0.2003 | 0.7764 | 0.2659 | 0.6070 |
|     |         |         | 0.2469 | 0.6213 | 0.2296 | 0.7543 |

Tolerance for each bin limit is  $\pm 0.5$  nm

### Blue Color Bin Table

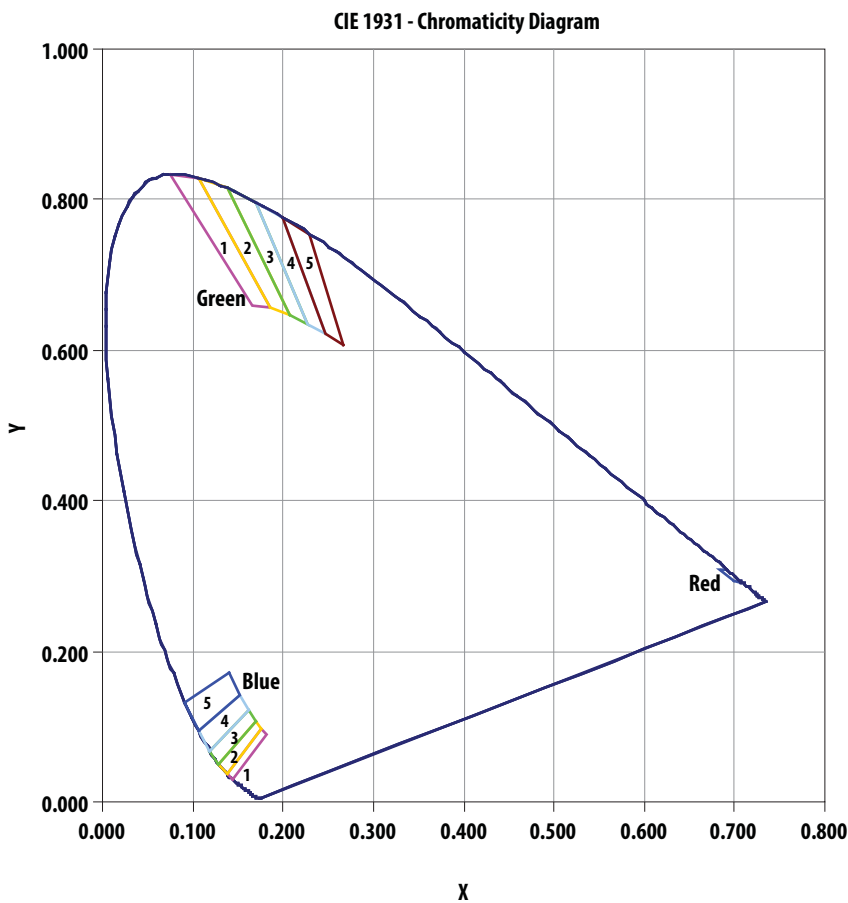
| Bin | Min Dom | Max Dom | Xmin   | Ymin   | Xmax   | Ymax   |
|-----|---------|---------|--------|--------|--------|--------|
| 1   | 460.0   | 464.0   | 0.1440 | 0.0297 | 0.1766 | 0.0966 |
|     |         |         | 0.1818 | 0.0904 | 0.1374 | 0.0374 |
| 2   | 464.0   | 468.0   | 0.1374 | 0.0374 | 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  $\pm 0.5$  nm

Note:

- All bin categories are established for classification of products. Products may not be available in all bin categories. Please contact your Avago representative for further information.

### Avago Color Bin on CIE 1931 Chromaticity Diagram



## Precautions:

### Lead Forming:

- The leads of an LED lamp may be preformed or cut to length prior to insertion and soldering on PC board.
- For better control, it is recommended to use proper tool to precisely form and cut the leads to applicable length rather than doing it manually.
- If manual lead cutting is necessary, cut the leads after the soldering process. The solder connection forms a mechanical ground which prevents mechanical stress due to lead cutting from traveling into LED package. This is highly recommended for hand solder operation, as the excess lead length also acts as small heat sink.

### Soldering and Handling:

- Care must be taken during PCB assembly and soldering process to prevent damage to the LED component.
- LED component may be effectively hand soldered to PCB. However, it is only recommended under unavoidable circumstances such as rework. The closest manual soldering distance of the soldering heat source (soldering iron's tip) to the body is 1.59 mm. Soldering the LED using soldering iron tip closer than 1.59 mm might damage the LED.



- ESD precaution must be properly applied on the soldering station and personnel to prevent ESD damage to the LED component that is ESD sensitive. Do refer to Avago application note AN 1142 for details. The soldering iron used should have grounded tip to ensure electrostatic charge is properly grounded.
- Recommended soldering condition:

|                      | Wave Soldering [1,2] | Manual Solder Dipping |
|----------------------|----------------------|-----------------------|
| Pre-heat temperature | 105° C Max.          | –                     |
| Preheat time         | 60 sec Max           | –                     |
| Peak temperature     | 260° C Max.          | 260° C Max.           |
| Dwell time           | 5 sec Max.           | 5 sec Max             |

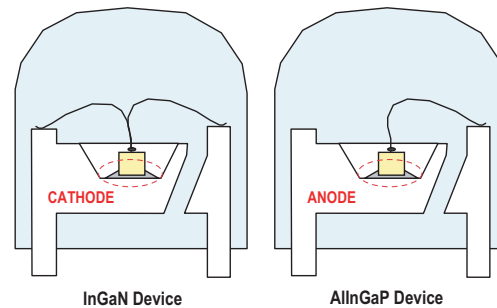
#### Note:

1. Above conditions refers to measurement with thermocouple mounted at the bottom of PCB.
  2. It is recommended to use only bottom preheaters in order to reduce thermal stress experienced by LED.
- Wave soldering parameters must be set and maintained according to the recommended temperature and dwell time. Customer is advised to perform daily check on the soldering profile to ensure that it is always conforming to recommended soldering conditions.

#### Note:

1. PCB with different size and design (component density) will have different heat mass (heat capacity). This might cause a change in temperature experienced by the board if same wave soldering setting is used. So, it is recommended to re-calibrate the soldering profile again before loading a new type of PCB.
2. Avago Technologies' AllnGaP high brightness LED are using high efficiency LED die with single wire bond as shown below. Customer is advised to take extra precaution during wave soldering to ensure that the maximum wave temperature does not exceed 260° C and the solder contact time does not exceeding 5 sec. Over-stressing the LED during soldering process might cause premature failure to the LED due to delamination.

### Avago Technologies LED configuration



- Any alignment fixture that is being applied during wave soldering should be loosely fitted and should not apply weight or force on LED. Non metal material is recommended as it will absorb less heat during wave soldering process.
- At elevated temperature, LED is more susceptible to mechanical stress. Therefore, PCB must allowed to cool down to room temperature prior to handling, which includes removal of alignment fixture or pallet.
- If PCB board contains both through hole (TH) LED and other surface mount components, it is recommended that surface mount components be soldered on the top side of the PCB. If surface mount need to be on the bottom side, these components should be soldered using reflow soldering prior to insertion the TH LED.
- Recommended PC board plated through holes (PTH) size for LED component leads.

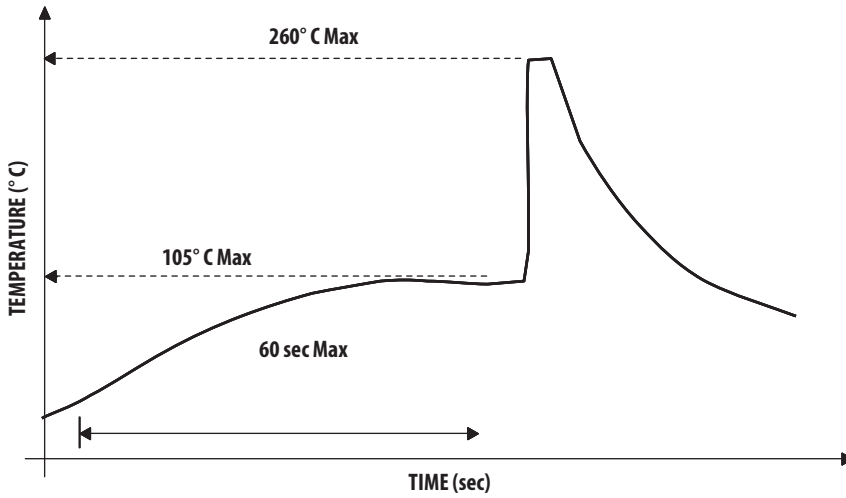
| LED component lead size               | Diagonal                 | Plated through hole diameter             |
|---------------------------------------|--------------------------|--|
| 0.45 x 0.45 mm<br>(0.018x 0.018 inch) | 0.636 mm<br>(0.025 inch) | 0.98 to 1.08 mm<br>(0.039 to 0.043 inch) |
| 0.50 x 0.50 mm<br>(0.020x 0.020 inch) | 0.707 mm<br>(0.028 inch) | 1.05 to 1.15 mm<br>(0.041 to 0.045 inch) |

- Over-sizing the PTH can lead to twisted LED after clinching. On the other hand under sizing the PTH can cause difficulty inserting the TH LED.

Refer to application note AN5334 for more information about soldering and handling of high brightness TH LED lamps.



### Example of Wave Soldering Temperature Profile for TH LED



Recommended solder:  
 Sn63 (Leaded solder alloy)  
 SAC305 (Lead free solder alloy)

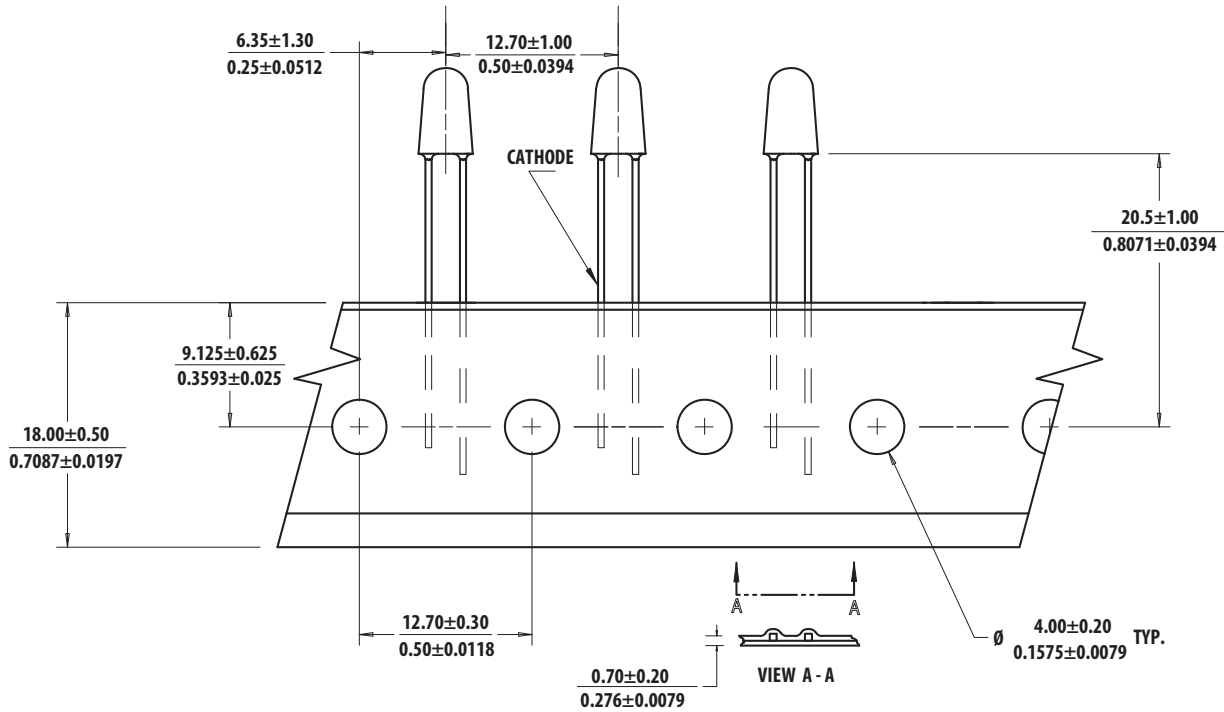
Flux: Rosin flux

Solder bath temperature: 255° C ± 5° C  
 (maximum peak temperature = 260° C)

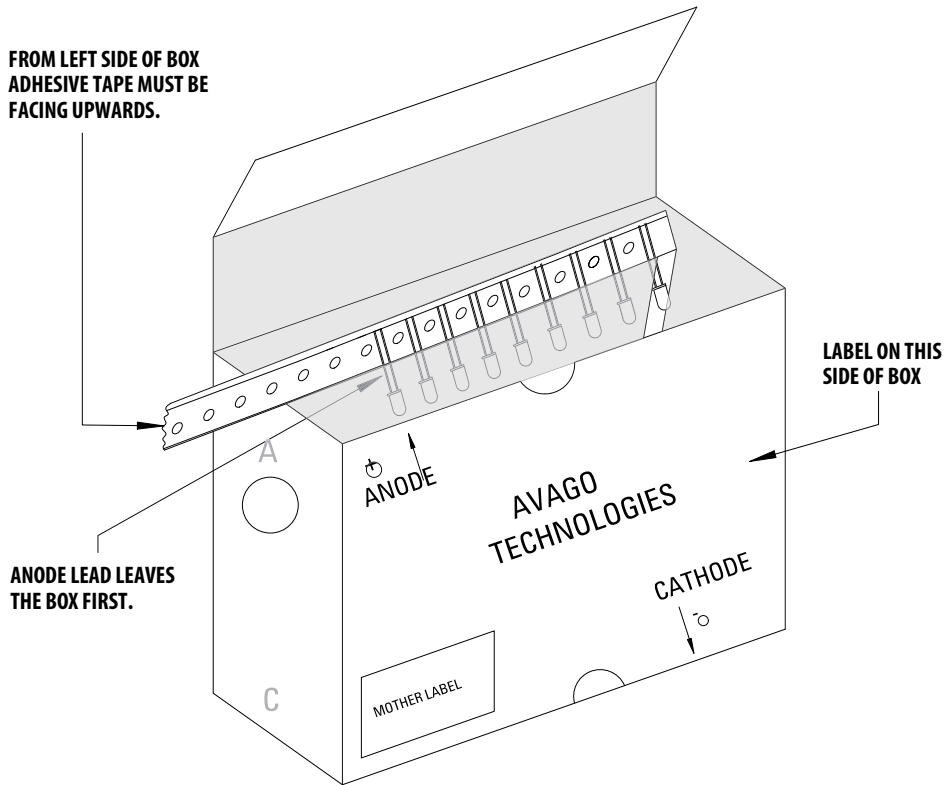
Dwell time: 3.0 sec - 5.0 sec  
 (maximum = 5 sec)

Note: Allow for board to be sufficiently cooled to room temperature before exerting mechanical force.

### Ammo Packs Drawing















## Packaging Box for Ammo Packs













Note: For InGaN device, the ammo pack packaging box contain ESD logo

## Packaging Label

(i) Avago Mother Label: (Available on packaging box of ammo pack and shipping box)

|   |   |
|---|---|
| <br><b>Avago</b><br>TECHNOLOGIES |   |
| (1P) Item: <b>Part Number</b>   | STANDARD LABEL LS0002   |
|                                  | RoHS Compliant  |
| (1T) Lot: <b>Lot Number</b>   | e3 max temp 260C  |
|                                  | (Q) QTY: <b>Quantity</b>  |
| LPN:  |  |
|                                  | CAT: <b>Intensity Bin</b>   |
| (9D)MFG Date: <b>Manufacturing Date</b>   |  |
|                                  | BIN: <b>Color Bin</b>   |
| <hr/>   |   |
| (P) Customer Item:  |   |
|                                  |   |
| (V) Vendor ID:  | (9D) Date Code: <b>Date Code</b>  |
|                                  |  |
| <hr/>   |   |
| DeptID:   | Made In: <b>Country of Origin</b>   |
|                                  |  |

(ii) Avago Baby Label (Only available on bulk packaging)

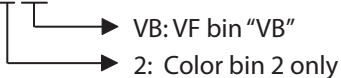
|   |   |   |
|---|---|---|
| <br><b>Avago</b><br>TECHNOLOGIES |   | RoHS Compliant<br>e3 max temp 260C  |
| <b>Lamps Baby Label</b>   |   |   |
| (1P) PART #: Part Number  |   |   |
|                                  |   |   |
| (1T) LOT #: Lot Number  |   |   |
|                                  |   |   |
| (9D)MFG DATE: Manufacturing Date  |   | QUANTITY: Packing Quantity  |
|                                  |   |  |
| C/O: Country of Origin  |   |   |
| Customer P/N:   | CAT: Intensity Bin  |   |
|                                  |  |   |
| Supplier Code:  | BIN: Color Bin  |   |
|                                  |  |   |
|   | DATECODE: Date Code   |   |
|   |  |   |

**Acronyms and Definition:**

**BIN:**

- (i) Color bin only or VF bin only  
(Applicable for part number with color bins but without VF bin OR part number with VF bins and no color bin)
- OR
- (ii) Color bin incorporated with VF Bin  
(Applicable for part number that have both color bin and VF bin)

**Example:**

- (i) Color bin only or VF bin only  
BIN: 2 (represent color bin 2 only)  
BIN: VB (represent VF bin "VB" only)
- (ii) Color bin incorporate with VF Bin  
BIN: 2VB  


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