

# HLMP-ADxx/AGxx/ALxx/BDxx/BGxx/BLxx

## 5mm mini Oval Precision Optical Performance

### AlInGaP Lamps



## Data Sheet



Lead (Pb) Free  
RoHS 6 fully  
compliant



### Description

These Precision Optical Performance Oval LEDs are specifically designed for full color/video and passenger information signs. The oval shaped radiation pattern (35° x 70°) and high luminous intensity ensure that these devices are excellent for wide field of view outdoor application where a wide viewing angle and readability in sunlight are essential. These lamps have very smooth, matched radiation patterns ensuring consistent color mixing in full color applications, message uniformity across the viewing angle of the sign.

High efficiency LED material is used in these lamps: Aluminum Indium Gallium Phosphide (AlInGaP) for amber and red. Each lamp is made with an advance optical grade epoxy offering superior high temperature and high moisture resistance in outdoor applications. The package epoxy contains both UV-A and UV-B inhibitors to reduce the effects of long term exposure to direct sunlight.

Designers can select parallel or perpendicular orientation. Both lamps are available in tinted version.

### Benefits

- Viewing angle designed for wide field of view application
- Superior performance in outdoor environments

### Features

- Well defined spatial radiation pattern
- Viewing angles:  
Major axis 70°  
Minor axis 35°
- High luminous output
- Red and Amber intensity are available for:  
AlInGaP (Bright)  
AlInGaP II (Brightest)
- Colors:  
626 nm red  
630 nm red  
590 nm amber  
592 nm amber
- Superior resistance to moisture
- UV resistant epoxy

### Applications

- Full color/video signs

**Table 1. Device Selection Guide for AlInGaP II**

| <b>Part Number</b> | <b>Color and Dominant Wavelength<br/><math>\lambda_d</math> (nm) Typ.</b> | <b>Luminous Intensity<br/>I<sub>v</sub> (mcd)<br/>at 20 mA Min.</b> | <b>Luminous Intensity<br/>I<sub>v</sub> (mcd)<br/>at 20 mA Max.</b> | <b>Stand-Off</b> | <b>Leadframe Orientation</b> | <b>Package Drawing</b> |
|--------------------|---|---|---|------------------|------------------------------|------------------------|
| HLMP-AD06-NSTxx    | Red 630   | 680   | 2500  | No               | Parallel                     | A                      |
| HLMP-AD06-P00xx    | Red 630   | 880   |   | No               | Parallel                     | A                      |
| HLMP-AD06-P0Txx    | Red 630   | 880   |   | No               | Parallel                     | A                      |
| HLMP-AD06-PQ0xx    | Red 630   | 880   | 1500  | No               | Parallel                     | A                      |
| HLMP-AD06-RSTxx    | Red 630   | 1500  | 2500  | No               | Parallel                     | A                      |
| HLMP-AD06-STTxx    | Red 630   | 1900  | 3200  | No               | Parallel                     | A                      |
| HLMP-AD16-P00xx    | Red 630   | 880   |   | Yes              | Parallel                     | B                      |
| HLMP-AD16-QTTxx    | Red 630   | 1150  | 3200  | Yes              | Parallel                     | B                      |
| HLMP-AD16-RS0xx    | Red 630   | 1500  | 2500  | Yes              | Parallel                     | B                      |
| HLMP-AD16-RSTxx    | Red 630   | 1500  | 2500  | Yes              | Parallel                     | B                      |
| HLMP-AD16-RUTxx    | Red 630   | 1500  | 4200  | Yes              | Parallel                     | B                      |
| HLMP-AD16-ST0xx    | Red 630   | 1900  | 3200  | Yes              | Parallel                     | B                      |
| HLMP-AD16-STTxx    | Red 630   | 1900  | 3200  | Yes              | Parallel                     | B                      |
| HLMP-AL16-RSRxx    | Amber 592   | 1500  | 2500  | Yes              | Parallel                     | B                      |
| HLMP-AL16-RSKxx    | Amber 592   | 1500  | 2500  | Yes              | Parallel                     | B                      |
| HLMP-BD06-L00xx    | Red 630   | 400   |   | No               | Perpendicular                | C                      |
| HLMP-BD06-P00xx    | Red 630   | 880   |   | No               | Perpendicular                | C                      |
| HLMP-BD06-RS0xx    | Red 630   | 1500  | 2500  | No               | Perpendicular                | C                      |
| HLMP-BD06-RSTxx    | Red 630   | 1500  | 2500  | No               | Perpendicular                | C                      |
| HLMP-BD06-STTxx    | Red 630   | 1900  | 3200  | No               | Perpendicular                | C                      |
| HLMP-BD16-NP0xx    | Red 630   | 680   | 1150  | Yes              | Perpendicular                | D                      |
| HLMP-BD16-QRTxx    | Red 630   | 1150  | 1900  | Yes              | Perpendicular                | D                      |
| HLMP-BD16-RU0xx    | Red 630   | 1500  | 4200  | Yes              | Perpendicular                | D                      |
| HLMP-BD16-RUTxx    | Red 630   | 1500  | 4200  | Yes              | Perpendicular                | D                      |
| HLMP-BD16-ST0xx    | Red 630   | 1900  | 3200  | Yes              | Perpendicular                | D                      |
| HLMP-BD16-STTxx    | Red 630   | 1900  | 3200  | Yes              | Perpendicular                | D                      |
| HLMP-BL06-N00xx    | Amber 592   | 680   |   | No               | Perpendicular                | C                      |

**Table 2. Device Selection Guide for AlInGaP**

| <b>Part Number</b> | <b>Color and Dominant Wavelength<br/><math>\lambda_d</math> (nm) Typ.</b> | <b>Luminous Intensity<br/>I<sub>v</sub> (mcd)<br/>at 20 mA Min.</b> | <b>Luminous Intensity<br/>I<sub>v</sub> (mcd)<br/>at 20 mA Max.</b> | <b>Stand-Off</b> | <b>Leadframe Orientation</b> | <b>Package Drawing</b> |
|--------------------|---|---|---|------------------|------------------------------|------------------------|
| HLMP-AG01-K00xx    | Red 626   | 310   |   | No               | Parallel                     | A                      |
| HLMP-AL01-L00xx    | Amber 590   | 400   |   | No               | Parallel                     | A                      |
| HLMP-AL01-LP0xx    | Amber 590   | 400   | 1150  | No               | Parallel                     | A                      |
| HLMP-AL01-N00xx    | Amber 590   | 680   |   | No               | Parallel                     | A                      |
| HLMP-AL01-NR0xx    | Amber 590   | 680   | 1900  | No               | Parallel                     | A                      |
| HLMP-AL01-PQKxx    | Amber 590   | 880   | 1150  | No               | Parallel                     | A                      |
| HLMP-AL11-NR0xx    | Amber 590   | 880   | 1900  | Yes              | Parallel                     | B                      |
| HLMP-BG01-LM0xx    | Red 626   | 400   | 520   | No               | Perpendicular                | C                      |
| HLMP-BG01-MN0xx    | Red 626   | 520   | 680   | No               | Perpendicular                | C                      |
| HLMP-BL01-NR0xx    | Red 626   | 680   | 1900  | No               | Perpendicular                | C                      |
| HLMP-BL11-KN0xx    | Red 626   | 310   | 880   | Yes              | Perpendicular                | D                      |
| HLMP-BL11-NR0xx    | Red 626   | 680   | 1900  | Yes              | Perpendicular                | D                      |

## Part Numbering System

HLMP - X X X X - X X X XX

### Mechanical Options

00: Bulk Packaging  
DD: Ammo Pack  
YY: Flexi-Bin; Bulk Packaging  
ZZ: Flexi-Bin; Ammo Pack

### Color Bin

0: No Color Bin Limitation  
B: Color bin 2 and 3 only  
K: Color bins 2 and 4 only  
R: Color Bins 1, 2, 4, and 6 with  $V_F$  max of 2.6 V  
S: Color bins 2 and 4 with  $V_F$  max of 2.6 V  
T: Red Color with  $V_F$  max of 2.6 V

### Maximum Intensity Bin

0: No  $I_v$  Bin Limitation

### Minimum Intensity Bin

### Tint Option

1 or 6: Matching Color Tints

### Standoff Option

0: Without  
1: With

### Color

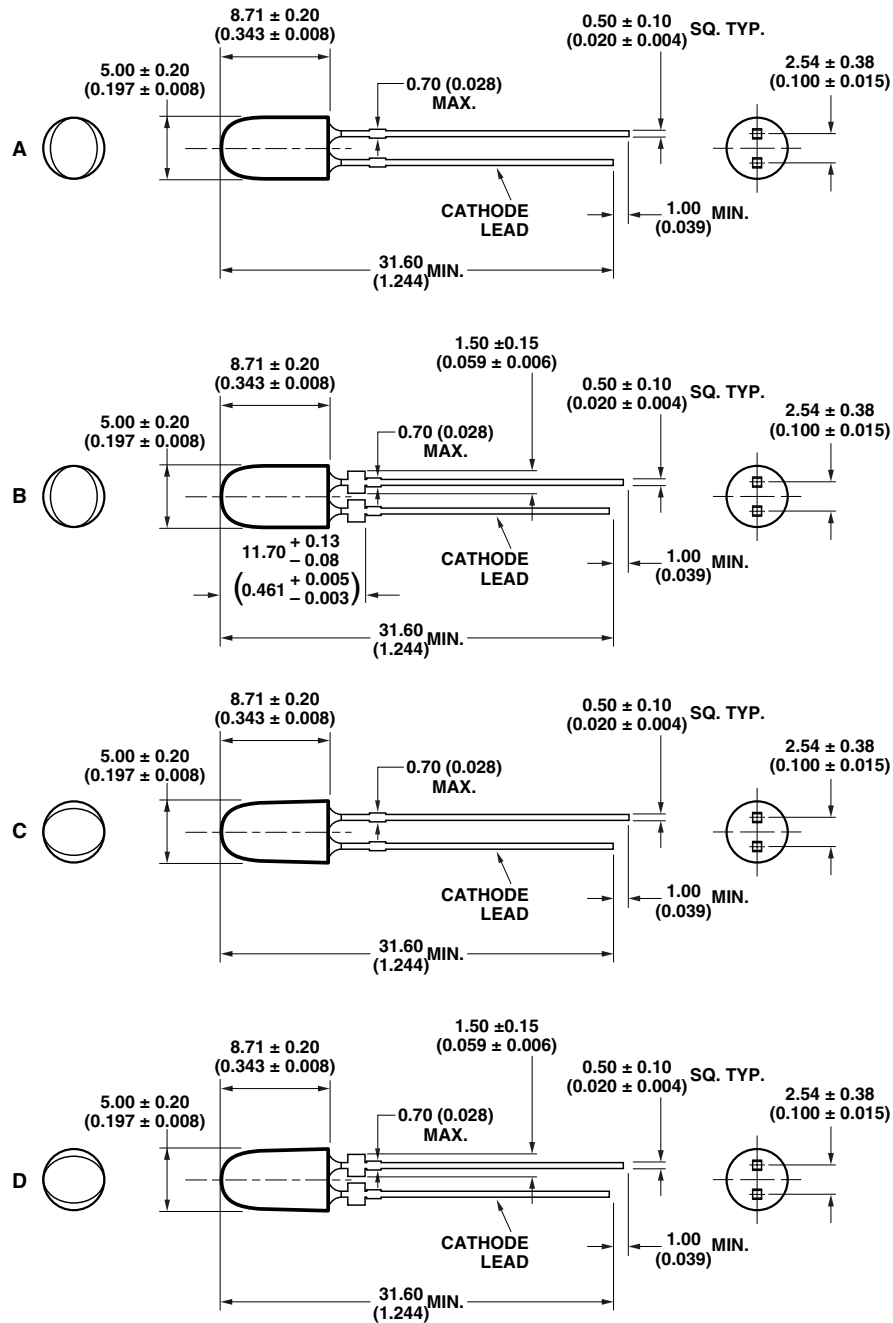
D: 630 nm Red  
G: 626 nm Red  
L: 590 or 592 nm Amber

### Package

A: 5 mm Mini Oval, Parallel  
B: 5 mm Mini Oval, Perpendicular

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

## Package Dimensions



### NOTES:

- ALL DIMENSIONS ARE IN MILLIMETERS (INCHES).
- TAPERS SHOWN AT TOP OF LEADS (BOTTOM OF LAMP PACKAGE) INDICATE AN EPOXY MENISCUS THAT MAY EXTEND ABOUT 1 mm (0.040 IN.) DOWN THE LEADS.
- RECOMMENDED PC BOARD HOLE DIAMETERS:
  - LAMP PACKAGES A AND C WITHOUT STAND-OFFS: FLUSH MOUNTING AT BASE OF LAMP PACKAGE = 1.143/1.067 mm (0.044/0.042 IN.).
  - LAMP PACKAGES B AND D WITH STAND-OFFS: MOUNTING AT LEAD STAND-OFFS.

### Absolute Maximum Ratings at $T_A = 25^\circ\text{C}$

| Parameter                                    | Red and Amber   |
|--|-----------------|
| DC Forward Current <sup>[1]</sup>            | 50 mA           |
| Peak Pulsed Forward Current <sup>[2]</sup>   | 100 mA          |
| Average Forward Current                      | 30 mA           |
| Reverse Voltage ( $I_R = 100\ \mu\text{A}$ ) | 5 V             |
| Power Dissipation                            | 120 mW          |
| LED Junction Temperature                     | 130°C           |
| Operating Temperature Range                  | -40°C to +100°C |
| Storage Temperature Range                    | -40°C to +100°C |

Notes:

1. Derate linearly as shown in figure 4.
2. Duty Factor 30%, Frequency 1kHz.

### Electrical/Optical Characteristics at $T_A = 25^\circ\text{C}$

| Parameter                              | Symbol                  | Min. | Typ. | Max. | Units | Test Conditions  |
|--|-------------------------|------|------|------|-------|--|
| Typical Viewing Angle                  |                         |      |      |      |       |  |
| Major                                  | $2\theta_{1/2}$         |      | 70   |      | deg   |  |
| Minor                                  |                         |      | 35   |      |       |  |
| Forward Voltage                        | $V_F$                   |      |      |      | V     | $I_F = 20\ \text{mA}$  |
| Red ( $\lambda_d = 626\ \text{nm}$ )   |                         |      | 2.0  | 2.4  |       |  |
| Red ( $\lambda_d = 630\ \text{nm}$ )   |                         |      |      |      |       |  |
| Option xx0xx                           |                         |      | 2.2  | 2.4  |       |  |
| Option xxTxx                           |                         |      | 2.3  | 2.6  |       |  |
| Amber ( $\lambda_d = 590\ \text{nm}$ ) |                         |      | 2.0  | 2.4  |       |  |
| Amber ( $\lambda_d = 592\ \text{nm}$ ) |                         |      |      |      |       |  |
| Option xx0xx                           |                         |      | 2.2  | 2.4  |       |  |
| Option xxRxx, xxSxx                    |                         |      | 2.3  | 2.6  |       |  |
| Reverse Voltage                        |                         |      |      |      |       |  |
| Amber, Red                             | $V_R$                   | 5    | 20   |      | V     | $I_R = 100\ \mu\text{A}$   |
| Peak Wavelength                        |                         |      |      |      |       |  |
| Amber ( $\lambda_d = 592\ \text{nm}$ ) | $\lambda_{\text{peak}}$ |      | 594  |      | nm    | Peak of Wavelength of Spectral Distribution at $I_F = 20\ \text{mA}$               |
| Red ( $\lambda_d = 630\ \text{nm}$ )   |                         |      | 639  |      |       |  |
| Spectral Halfwidth                     |                         |      |      |      |       |  |
| Amber ( $\lambda_d = 592\ \text{nm}$ ) | $\Delta\lambda_{1/2}$   |      | 17   |      | nm    | Wavelength Width at Spectral Distribution 1/2 Power Point at $I_F = 20\ \text{mA}$ |
| Red ( $\lambda_d = 630\ \text{nm}$ )   |                         |      | 17   |      |       |  |
| Capacitance                            |                         |      |      |      |       | $V_F = 0, F = 1\ \text{MHz}$   |
| Amber, Red                             | C                       |      | 40   |      | pF    |  |
| Luminous Efficacy                      |                         |      |      |      |       | Emitted Luminous Power/Emitted Radiant Power at $I_F = 20\ \text{mA}$              |
| Amber ( $\lambda_d = 592\ \text{nm}$ ) | $\eta_v$                |      | 500  |      | lm/W  |  |
| Red ( $\lambda_d = 630\ \text{nm}$ )   |                         |      | 155  |      |       |  |
| Thermal Resistance                     | $R\Theta_{J-PIN}$       |      | 240  |      | °C/W  | LED Junction-to-Cathode Lead   |

Notes:

1.  $2\theta_{1/2}$  is the off-axis angle where the luminous intensity is 1/2 the on-axis intensity.
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. The luminous intensity is measured on the mechanical axis of the lamp package.
4. The optical axis is closely aligned with the package mechanical axis.
5. The dominant wavelength,  $\lambda_d$ , is derived from the CIE Chromaticity Diagram and represents the color of the lamp.
6. For Options -xxRxx, -xxSxx and -xxTxx, max. forward voltage ( $V_f$ ) is 2.6 V. Refer to  $V_f$  bin table.

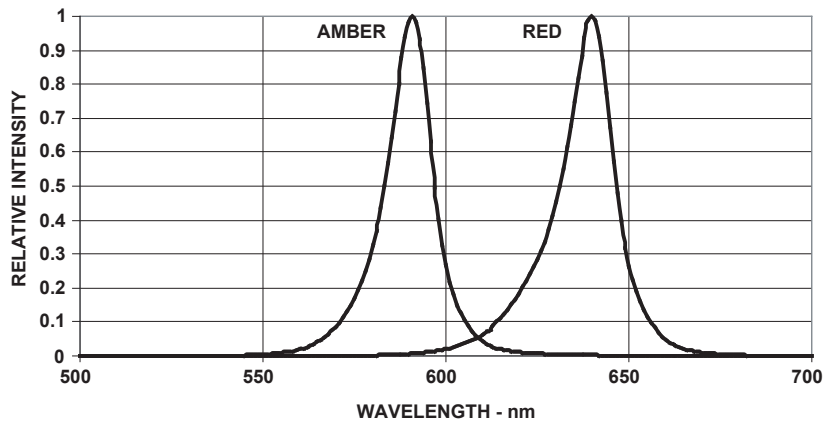


Figure 1. Relative intensity vs. wavelength.

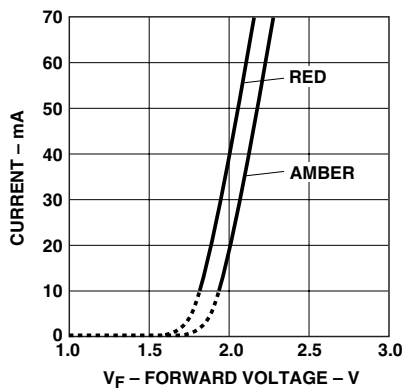


Figure 2a. Amber, red forward current vs. forward voltage.

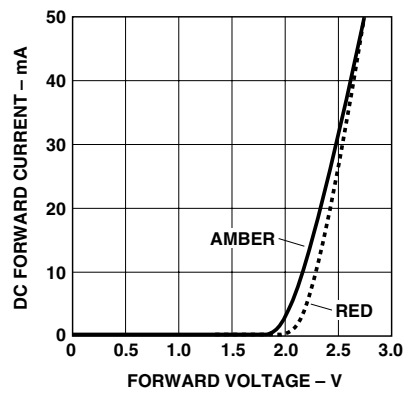


Figure 2b. Forward current vs. forward voltage for option -xxTxx red, and option -xxRxx and -xxSxx amber.

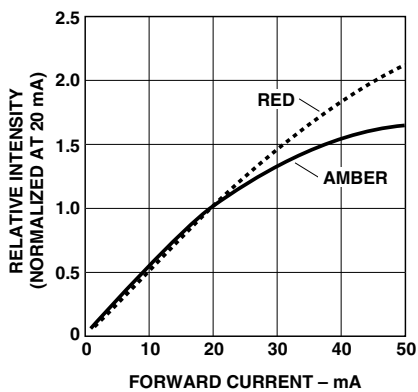


Figure 3. Amber, red relative luminous intensity vs. forward current.

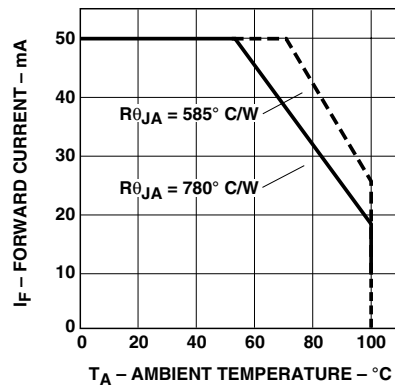


Figure 4. Amber, red maximum forward current vs. ambient temperature.

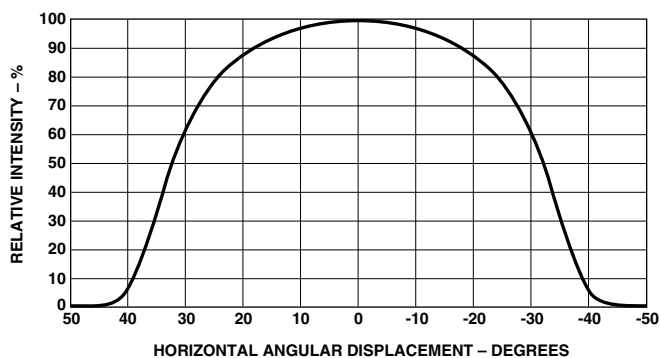
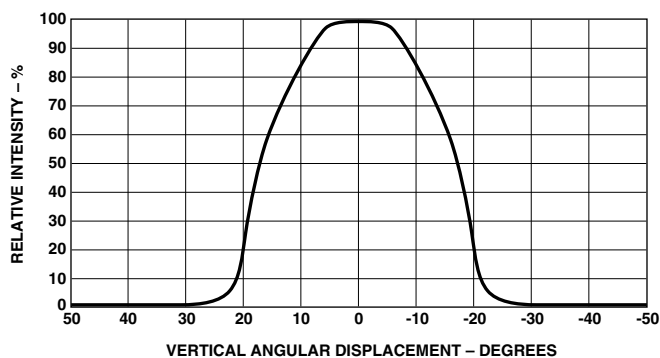


Figure 5. Spatial radiation pattern – 35 x 70 degree lamps.

#### Intensity Bin Limits (mcd at 20 mA)

| Bin Name | Min. | Max. |
|----------|------|------|
| K        | 310  | 400  |
| L        | 400  | 520  |
| M        | 520  | 680  |
| N        | 680  | 880  |
| P        | 880  | 1150 |
| Q        | 1150 | 1500 |
| R        | 1500 | 1900 |
| S        | 1900 | 2500 |
| T        | 2500 | 3200 |
| U        | 3200 | 4200 |

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

#### Amber Color Bin Limits (nm at 20 mA)

| Bin Name | Min.  | Max.  |
|----------|-------|-------|
| 1        | 584.5 | 587.0 |
| 2        | 587.0 | 589.5 |
| 4        | 589.5 | 592.0 |
| 6        | 592.0 | 594.5 |

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

#### Vf Bin Table [2,3]

| Bin Id | Min. | Max. |
|--------|------|------|
| VA     | 2.0  | 2.2  |
| VB     | 2.2  | 2.4  |
| VC     | 2.4  | 2.6  |

Notes:

1. 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.
2. Vf bin table only available for those numbers with options -xxRxx, -xxSxx, -xxTxx.
3. Tolerance for each bin limit is  $\pm 0.05V$



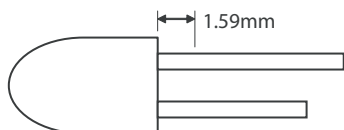
## Precautions:

### 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 1.59mm. Soldering the LED using soldering iron tip closer than 1.59mm 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     | 250 °C Max.           | 260 °C Max.           |
| Dwell time           | 3 sec Max.            | 5 sec Max             |

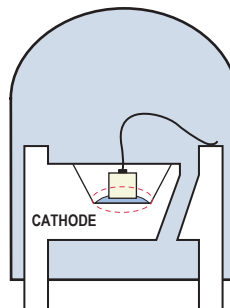
#### Note:

- 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' 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 250°C and the solder contact time does not exceeding 3sec. Over-stressing the LED during soldering process might cause premature failure to the LED due to delamination.

### Avago Technologies LED configuration



Note: Electrical connection between bottom surface of LED die and the lead frame is achieved through conductive paste.

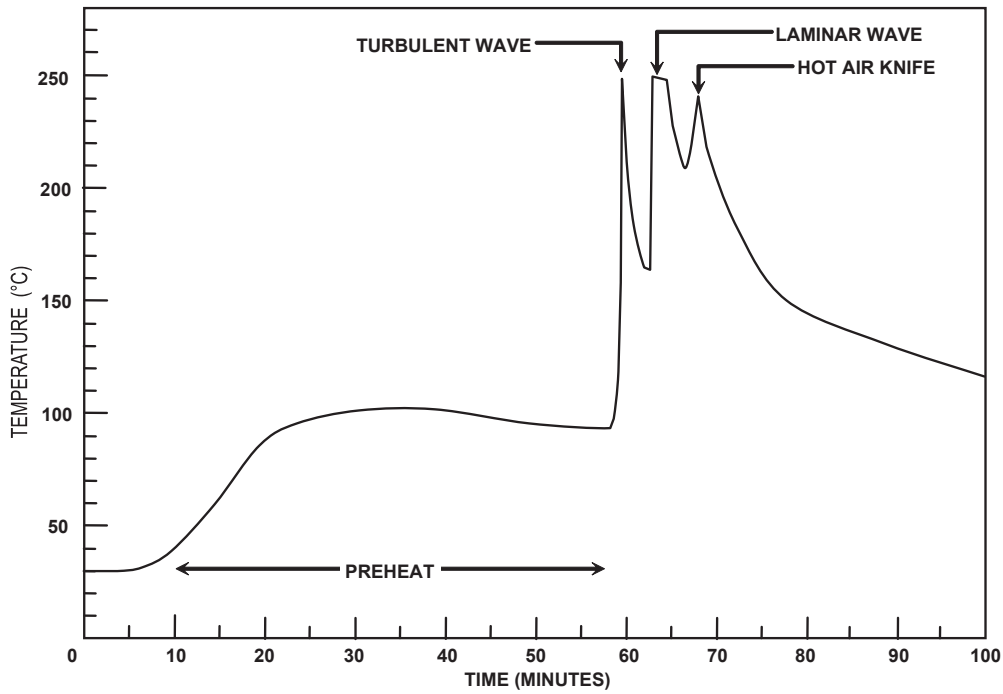
- Any alignment fixture that is being applied during wave soldering should be loosely fitted and should not apply weight or force on LED. Non metal material is recommended as it will absorb less heat during wave soldering process.
- At elevated temperature, LED is more susceptible to mechanical stress. 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)

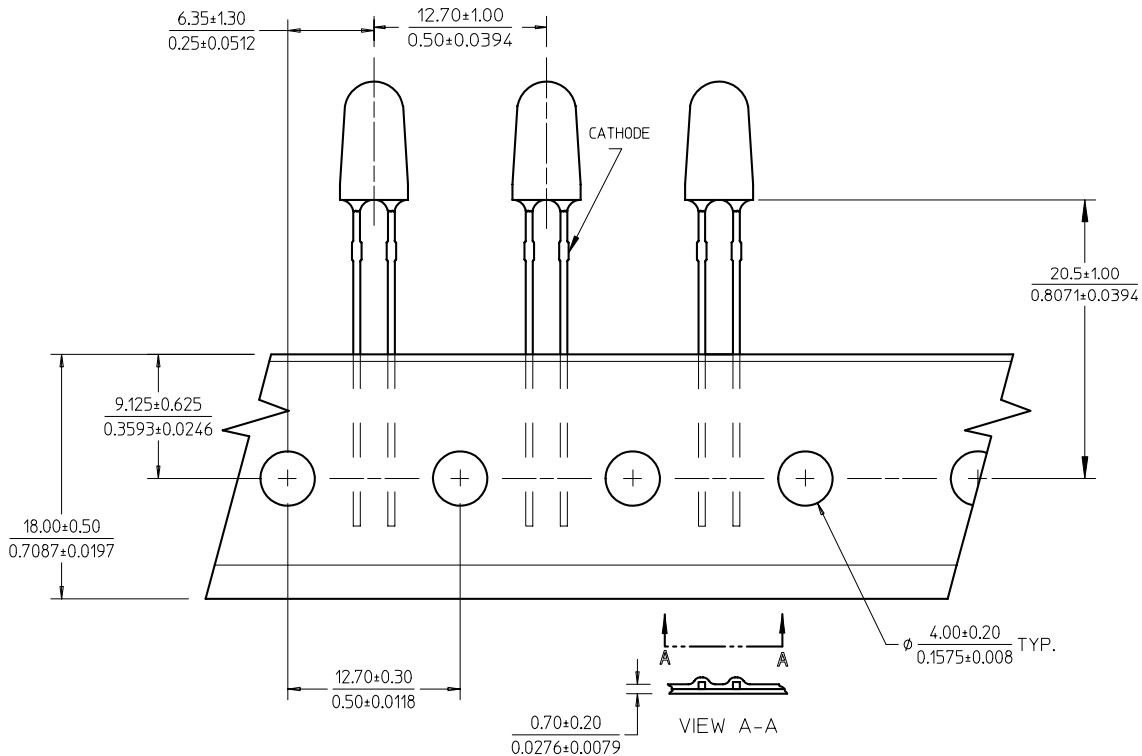
Flux: Rosin flux

Solder bath temperature:  
245°C ± 5°C (maximum peak  
temperature = 250°C)

Dwell time: 1.5 sec - 3.0 sec  
(maximum = 3sec)

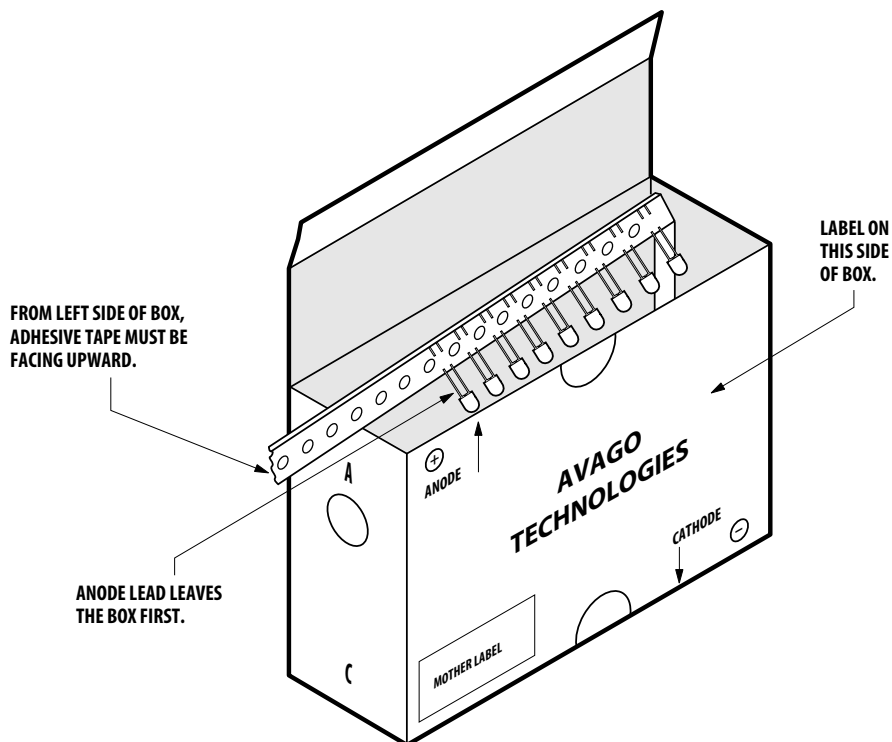
Note: Allow for board to be sufficiently  
cooled to room temperature before  
exerting mechanical force.

### Ammo Packs Drawing



**Note:** The ammo-packs drawing is applicable for packaging option –DD & –ZZ and regardless of standoff or non-standoff.

## Packaging Box for Ammo Packs



**Note:** For InGaN device, the ammo pack packaging box contains ESD logo.

## Packaging Label

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

|   |  |
|---|--|
| <b>Avago</b><br>TECHNOLOGIES<br>STANDARD LABEL LS0002<br>RoHS Compliant<br>e3 max temp 250C |  |
| (1P) Item: <b>Part Number</b>   | (Q) QTY: <b>Quantity</b>               |
| (1T) Lot: <b>Lot Number</b>   | CAT: <b>Intensity Bin</b>              |
| LPN:  | BIN: <b>Refer to below information</b> |
| (9D)MFG Date: <b>Manufacturing Date</b>   |  |
| <hr/> (P) Customer Item:<br>(V) Vendor ID:  |  |
| (9D) Date Code: <b>Date Code</b>  |  |
| DeptID:   | Made In: <b>Country of Origin</b>      |

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

|                                      |  |                                     |  |
|--------------------------------------|--|-------------------------------------|--|
| <b>Avago</b><br>TECHNOLOGIES         |  | RoHS Compliant<br>e3 max temp 250C  |  |
| <b>Lamps Baby Label</b>              |  |                                     |  |
| (1P) PART #: Part Number<br>         |  |                                     |  |
| (1T) LOT #: Lot Number<br>           |  |                                     |  |
| (9D)MFG DATE: Manufacturing Date<br> |  | QUANTITY: Packing Quantity<br>      |  |
| C/O: Country of Origin               |  |                                     |  |
| Customer P/N:<br>                    |  | CAT: Intensity Bin<br>              |  |
| Supplier Code:<br>                   |  | BIN: Refer to below information<br> |  |
|                                      |  | DATECODE: Date Code<br>             |  |

#### 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:

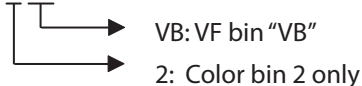
(i) Color bin only or VF bin only

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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