

## HLMP-Cxxx

T-13/4 (5 mm) Precision Optical Performance  
InGaN Blue, Green and Cyan Lamps



## Data Sheet

HLMP-CB15, HLMP-CB16, HLMP-CB30, HLMP-CB31, HLMP-CM15, HLMP-CM16, HLMP-CM30,  
HLMP-CM31, HLMP-CE15, HLMP-CE16, HLMP-CE23, HLMP-CE24, HLMP-CE30, HLMP-CE31

### Description

These high intensity blue, green and cyan LEDs are based on InGaN material technology. InGaN is the most efficient and cost effective material for LEDs in the blue and green region of the spectrum. The 472 nm typical dominant wavelength for blue and 526 nm typical dominant wavelength for green are well suited to color mixing in full color signs. The 505 nm typical dominant wavelength matches international specifications for green traffic signals. These LED lamps are untinted, nondiffused, T-13/4 packages incorporating second generation optics which produce well defined spatial radiation patterns at specific viewing cone angles. These lamps are made with an advanced optical grade epoxy, offering superior high temperature and high moisture resistance performance in outdoor signal and sign applications. The high maximum LED junction temperature limit of +130°C enables high temperature operation in bright sunlight conditions. The package epoxy contains both UV-A and UV-B inhibitors to reduce the effects of long term exposure to direct sunlight. These lamps are available in two viewing angle for Green and Blue, and 3 viewing angles options for Cyan to give the designer flexibility with optical design.

### Features

- Well defined spatial radiation pattern
- Viewing angles: 15°, 23° and 30°
- High luminous output
- Colors: 472 nm Blue, 526 nm Green, 505 nm Cyan
- Superior resistance to moisture
- UV resistant epoxy

### Benefits

- Superior performance in outdoor environments
- Wavelengths suitable for color mixing in full color (RGB) signs

### Applications

- Commercial outdoor signs
- Automotive interior lights
- Front panel indicators
- Front panel backlighting

*CAUTION: HLMP-CBxx, HLMP-CMxx and HLMP-CExx LEDs are Class 1C ESD sensitive. Please observe appropriate precautions during handling and processing. Refer to Avago Application Note AN-1142 for additional details.*

## Device Selection Guide

| Part Number     | Typical Viewing Angle<br>2θ <sub>1/2</sub> (Deg) <sup>[1]</sup> | Color and Typ.<br>Dominant Wavelength<br>λ <sub>d</sub> (nm) <sup>[2]</sup> | Luminous Intensity,<br>I <sub>v</sub> (mcd) at 20 mA <sup>[3,4,5]</sup> |       | Leads with<br>Stand-Offs | Package<br>Drawing |
|-----------------|-----------------------------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------|-------|--------------------------|--------------------|
|                 |                                                                 |                                                                             | Min.                                                                    | Max.  |                          |                    |
| HLMP-CB15-P00xx | 15°                                                             | Blue 472                                                                    | 880                                                                     | -     | No                       | A                  |
| HLMP-CB15-QT0xx | 15°                                                             | Blue 472                                                                    | 1150                                                                    | 3200  | No                       | A                  |
| HLMP-CB15-R00xx | 15°                                                             | Blue 472                                                                    | 1500                                                                    | -     | No                       | A                  |
| HLMP-CB15-RSCxx | 15°                                                             | Blue 472                                                                    | 1500                                                                    | 2500  | No                       | A                  |
| HLMP-CB16-P00xx | 15°                                                             | Blue 472                                                                    | 880                                                                     | -     | Yes                      | B                  |
| HLMP-CB16-QT0xx | 15°                                                             | Blue 472                                                                    | 1150                                                                    | 3200  | Yes                      | B                  |
| HLMP-CM15-S00xx | 15°                                                             | Green 526                                                                   | 1900                                                                    | -     | No                       | A                  |
| HLMP-CM15-SV0xx | 15°                                                             | Green 526                                                                   | 1900                                                                    | 5500  | No                       | A                  |
| HLMP-CM15-VY0xx | 15°                                                             | Green 526                                                                   | 4200                                                                    | 12000 | No                       | A                  |
| HLMP-CM15-W00xx | 15°                                                             | Green 526                                                                   | 5500                                                                    | -     | No                       | A                  |
| HLMP-CM15-WXBxx | 15°                                                             | Green 526                                                                   | 5500                                                                    | 9300  | No                       | A                  |
| HLMP-CM15-WZ0xx | 15°                                                             | Green 526                                                                   | 5500                                                                    | 16000 | No                       | A                  |
| HLMP-CM16-S00xx | 15°                                                             | Green 526                                                                   | 1900                                                                    | -     | Yes                      | B                  |
| HLMP-CM16-VY0xx | 15°                                                             | Green 526                                                                   | 4200                                                                    | 12000 | Yes                      | B                  |
| HLMP-CM16-WYGxx | 15°                                                             | Green 526                                                                   | 5500                                                                    | 12000 | Yes                      | B                  |
| HLMP-CE15-VWCxx | 15°                                                             | Cyan 505                                                                    | 4200                                                                    | 7200  | No                       | A                  |
| HLMP-CE15-WZCxx | 15°                                                             | Cyan 505                                                                    | 5500                                                                    | 16000 | No                       | A                  |
| HLMP-CE15-WZQxx | 15°                                                             | Cyan 505                                                                    | 5500                                                                    | 16000 | No                       | A                  |
| HLMP-CE16-UXQxx | 15°                                                             | Cyan 505                                                                    | 3200                                                                    | 9300  | Yes                      | B                  |
| HLMP-CE16-WZBxx | 15°                                                             | Cyan 505                                                                    | 5500                                                                    | 16000 | Yes                      | B                  |
| HLMP-CE16-WZCxx | 15°                                                             | Cyan 505                                                                    | 5500                                                                    | 16000 | Yes                      | B                  |
| HLMP-CE16-WZQxx | 15°                                                             | Cyan 505                                                                    | 5500                                                                    | 16000 | Yes                      | B                  |
| HLMP-CE23-UVQxx | 23°                                                             | Cyan 505                                                                    | 3200                                                                    | 5500  | No                       | A                  |
| HLMP-CE23-UXCxx | 23°                                                             | Cyan 505                                                                    | 3200                                                                    | 9300  | No                       | A                  |
| HLMP-CE23-UXQxx | 23°                                                             | Cyan 505                                                                    | 3200                                                                    | 9300  | No                       | A                  |
| HLMP-CE23-VWCxx | 23°                                                             | Cyan 505                                                                    | 4200                                                                    | 7200  | No                       | A                  |
| HLMP-CE23-VWQxx | 23°                                                             | Cyan 505                                                                    | 4200                                                                    | 7200  | No                       | A                  |
| HLMP-CE23-VXQxx | 23°                                                             | Cyan 505                                                                    | 4200                                                                    | 9300  | No                       | A                  |
| HLMP-CE23-VYCxx | 23°                                                             | Cyan 505                                                                    | 4200                                                                    | 12000 | No                       | A                  |
| HLMP-CE24-UX0xx | 23°                                                             | Cyan 505                                                                    | 3200                                                                    | 9300  | Yes                      | B                  |
| HLMP-CE24-UXCxx | 23°                                                             | Cyan 505                                                                    | 3200                                                                    | 9300  | Yes                      | B                  |
| HLMP-CE24-UXQxx | 23°                                                             | Cyan 505                                                                    | 3200                                                                    | 9300  | Yes                      | B                  |
| HLMP-CE24-VXQxx | 23°                                                             | Cyan 505                                                                    | 4200                                                                    | 9300  | Yes                      | B                  |
| HLMP-CE24-VYCxx | 23°                                                             | Cyan 505                                                                    | 4200                                                                    | 12000 | Yes                      | B                  |
| HLMP-CE24-VYQxx | 23°                                                             | Cyan 505                                                                    | 4200                                                                    | 12000 | Yes                      | B                  |

## Device Selection Guide (Continued)

| Part Number     | Typical Viewing Angle $2\theta_{1/2}$ (Deg) <sup>[1]</sup> | Color and Typ. Dominant Wavelength $\lambda_d$ (nm) <sup>[2]</sup> | Luminous Intensity, $I_v$ (mcd) at 20 mA <sup>[3,4,5]</sup> |      | Leads with Stand-Offs | Package Drawing |
|-----------------|------------------------------------------------------------|--------------------------------------------------------------------|-------------------------------------------------------------|------|-----------------------|-----------------|
|                 |                                                            |                                                                    | Min.                                                        | Max. |                       |                 |
| HLMP-CB30-K00xx | 30°                                                        | Blue 472                                                           | 310                                                         | -    | No                    | A               |
| HLMP-CB30-M00xx | 30°                                                        | Blue 472                                                           | 520                                                         | -    | No                    | A               |
| HLMP-CB30-NPCxx | 30°                                                        | Blue 472                                                           | 680                                                         | 1150 | No                    | A               |
| HLMP-CB30-NRGxx | 30°                                                        | Blue 472                                                           | 680                                                         | 1900 | No                    | A               |
| HLMP-CB30-PQCxx | 30°                                                        | Blue 472                                                           | 880                                                         | 1500 | No                    | A               |
| HLMP-CB31-M00xx | 30°                                                        | Blue 472                                                           | 520                                                         | -    | Yes                   | B               |
| HLMP-CB31-NRGxx | 30°                                                        | Blue 472                                                           | 680                                                         | 1900 | Yes                   | B               |
| HLMP-CB31-PQCxx | 30°                                                        | Blue 472                                                           | 880                                                         | 1500 | Yes                   | B               |
| HLMP-CM30-M00xx | 30°                                                        | Green 526                                                          | 520                                                         | -    | No                    | A               |
| HLMP-CM30-RSBxx | 30°                                                        | Green 526                                                          | 1500                                                        | 2500 | No                    | A               |
| HLMP-CM30-S00xx | 30°                                                        | Green 526                                                          | 1900                                                        | -    | No                    | A               |
| HLMP-CM30-TUCxx | 30°                                                        | Green 526                                                          | 2500                                                        | 4200 | No                    | A               |
| HLMP-CM30-TW0xx | 30°                                                        | Green 526                                                          | 2500                                                        | 7200 | No                    | A               |
| HLMP-CM30-TWAxx | 30°                                                        | Green 526                                                          | 2500                                                        | 7200 | No                    | A               |
| HLMP-CM30-UVAxx | 30°                                                        | Green 526                                                          | 3200                                                        | 5500 | No                    | A               |
| HLMP-CM30-UVCxx | 30°                                                        | Green 526                                                          | 3200                                                        | 5500 | No                    | A               |
| HLMP-CM31-M00xx | 30°                                                        | Green 526                                                          | 520                                                         | -    | Yes                   | B               |
| HLMP-CM31-S00xx | 30°                                                        | Green 526                                                          | 1900                                                        | -    | Yes                   | B               |
| HLMP-CM31-S0Dxx | 30°                                                        | Green 526                                                          | 1900                                                        | -    | Yes                   | B               |
| HLMP-CM31-TUCxx | 30°                                                        | Green 526                                                          | 2500                                                        | 4200 | Yes                   | B               |
| HLMP-CM31-TW0xx | 30°                                                        | Green 526                                                          | 2500                                                        | 7200 | Yes                   | B               |
| HLMP-CM31-TWAxx | 30°                                                        | Green 526                                                          | 2500                                                        | 7200 | Yes                   | B               |
| HLMP-CM31-UVCxx | 30°                                                        | Green 526                                                          | 3200                                                        | 5500 | Yes                   | B               |
| HLMP-CM31-VWCxx | 30°                                                        | Green 526                                                          | 4200                                                        | 7200 | Yes                   | B               |
| HLMP-CE30-RSCxx | 30°                                                        | Cyan 505                                                           | 1500                                                        | 2500 | No                    | A               |
| HLMP-CE30-RUCxx | 30°                                                        | Cyan 505                                                           | 1500                                                        | 4200 | No                    | A               |
| HLMP-CE30-STQxx | 30°                                                        | Cyan 505                                                           | 1900                                                        | 3200 | No                    | A               |
| HLMP-CE30-SVCxx | 30°                                                        | Cyan 505                                                           | 1900                                                        | 5500 | No                    | A               |
| HLMP-CE30-SVQxx | 30°                                                        | Cyan 505                                                           | 1900                                                        | 5500 | No                    | A               |
| HLMP-CE31-SVCxx | 30°                                                        | Cyan 505                                                           | 1900                                                        | 5500 | Yes                   | B               |
| HLMP-CE31-SVQxx | 30°                                                        | Cyan 505                                                           | 1900                                                        | 5500 | Yes                   | B               |

### Notes:

1.  $\theta_{1/2}$  is the off-axis angle where the luminous intensity is one half the on-axis intensity.
2. Dominant Wavelength,  $\lambda_d$ , is derived from the CIE Chromaticity. Diagram and represents the color of the lamp.
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. Tolerance for each intensity bin limit is  $\pm 15\%$ .

## Part Numbering System

HLMP - X X XX - X X X XX

### Mechanical Options

00: Bulk  
DD: Ammo Pack  
YY: Flexi bin, Bulk  
ZZ: Flexi bin, Ammo Pack

### Color Bin Selection

0: Full color range  
A: Color bin 1 & 2 only  
B: Color bin 2 & 3 only  
C: Color bin 3 & 4 only  
G: Color bin 2, 3 & 4 only  
Q: Color bin 7 & 8 only

### Maximum Intensity Bin

0: No maximum Iv bin limit  
Others: Refer to Intensity Bin Limit Table

### Minimum Intensity Bin

Refer to Device Selection Guide

### Viewing Angle and Standoff Options

15: 15 degree without standoff  
16: 15 degree with standoff  
23: 23 degree without standoff  
24: 23 degree with standoff  
30: 30 degree without standoff  
31: 30 degree with standoff

### Color

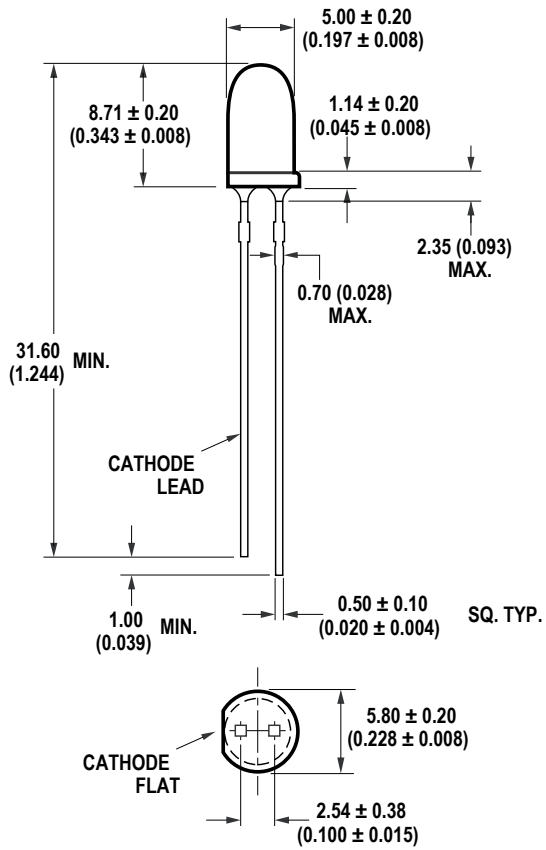
B: Blue  
M: Green  
E: Cyan

### Package

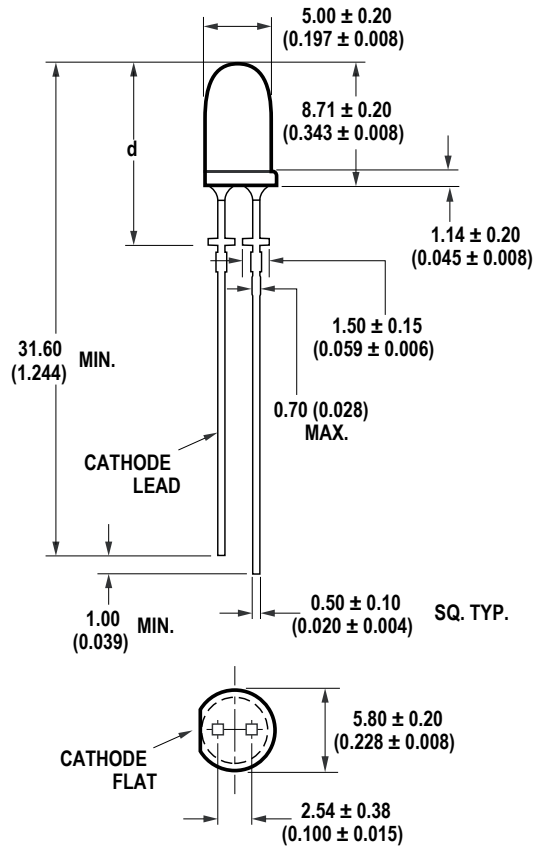
C: T-1 3/4 (5 mm) round lamp

## Package Dimensions

### Package A



### Package B



| HLMP-Cx16                                    | HLMP-Cx24                                     | HLMP-Cx31                                     |
|----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| $d = 12.6 \pm 0.18$<br>( $0.496 \pm 0.007$ ) | $d = 12.40 \pm 0.25$<br>( $0.488 \pm 0.010$ ) | $d = 12.22 \pm 0.50$<br>( $0.481 \pm 0.020$ ) |

#### Notes:

1. Dimensions in mm.
2. Tolerance  $\pm 0.1$  mm unless otherwise noted.

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

| Parameter                                    | Value       | Units            |
|----------------------------------------------|-------------|------------------|
| DC Forward Current <sup>[1]</sup>            | 30          | mA               |
| Peak Forward Current                         | 100         | mA               |
| Power Dissipation                            |             | mW               |
| Blue                                         | 111         |                  |
| Green / Cyan                                 | 117         |                  |
| Reverse Voltage ( $I_R = 100\ \mu\text{A}$ ) | 5           | V                |
| LED Junction Temperature                     | 130         | $^\circ\text{C}$ |
| Operating Temperature Range                  | -40 to +80  | $^\circ\text{C}$ |
| Storage Temperature Range                    | -40 to +100 | $^\circ\text{C}$ |

Note:

1. Derate linearly as shown in Figure 4 for temperatures above  $50^\circ\text{C}$ .
2. Duty Factor 10%, 1kHz

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

| Parameter                              | Symbol                  | Min. | Typ. | Max. | Units                     | Test Conditions                                                      |
|----------------------------------------|-------------------------|------|------|------|---------------------------|----------------------------------------------------------------------|
| Forward Voltage                        | $V_F$                   |      |      |      | V                         | $I_F = 20\ \text{mA}$                                                |
| Blue                                   |                         |      | 3.2  | 3.7  |                           |                                                                      |
| Green / Cyan                           |                         |      | 3.2  | 3.9  |                           |                                                                      |
| Reverse Voltage                        | $V_R$                   | 5    |      |      |                           | $I_R = 100\ \mu\text{A}$                                             |
| Peak Wavelength                        | $\lambda_{\text{peak}}$ |      |      |      | nm                        | Peak of Wavelength of Spectral Distribution at $I_F = 20\ \text{mA}$ |
| Blue ( $\lambda_d = 472\ \text{nm}$ )  |                         |      | 470  |      |                           |                                                                      |
| Green ( $\lambda_d = 526\ \text{nm}$ ) |                         |      | 524  |      |                           |                                                                      |
| Cyan ( $\lambda_d = 505\ \text{nm}$ )  |                         |      | 502  |      |                           |                                                                      |
| Spectral Halfwidth                     | $\Delta\lambda_{1/2}$   |      |      |      | nm                        | Wavelength Width at Spectral Power Point at $I_F = 20\ \text{mA}$    |
| Blue ( $\lambda_d = 472\ \text{nm}$ )  |                         |      | 35   |      |                           |                                                                      |
| Green ( $\lambda_d = 526\ \text{nm}$ ) |                         |      | 47   |      |                           |                                                                      |
| Cyan ( $\lambda_d = 505\ \text{nm}$ )  |                         |      | 35   |      |                           |                                                                      |
| Capacitance                            | C                       |      |      |      | pF                        | $V_F = 0, F = 1\ \text{MHz}$                                         |
| Blue/ Green                            |                         |      | 43   |      |                           |                                                                      |
| Cyan                                   |                         |      | 40   |      |                           |                                                                      |
| Luminous Efficacy                      | $\eta_v$                |      |      |      | lm/W                      | Emitted Luminous Power/Emitted Radiant Power                         |
| Blue ( $\lambda_d = 472\ \text{nm}$ )  |                         |      | 75   |      |                           |                                                                      |
| Green ( $\lambda_d = 526\ \text{nm}$ ) |                         |      | 520  |      |                           |                                                                      |
| Cyan ( $\lambda_d = 505\ \text{nm}$ )  |                         |      | 350  |      |                           |                                                                      |
| Thermal Resistance                     | $R\theta_{J-PIN}$       |      | 240  |      | $^\circ\text{C}/\text{W}$ | LED Junction-to-Cathode Lead                                         |

Notes:

1. The dominant wavelength,  $\lambda_d$ , is derived from the CIE Chromaticity Diagram and represents the perceived color of the device.
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.

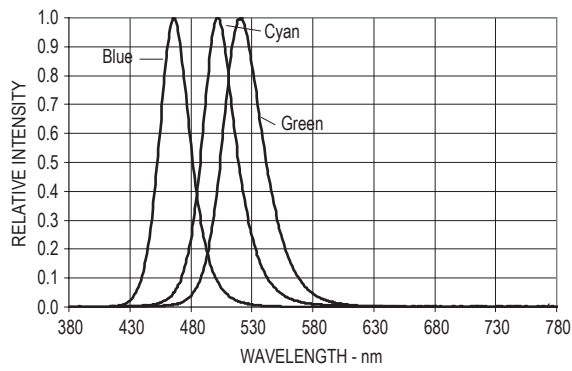


Figure 1. Relative intensity vs. wavelength.

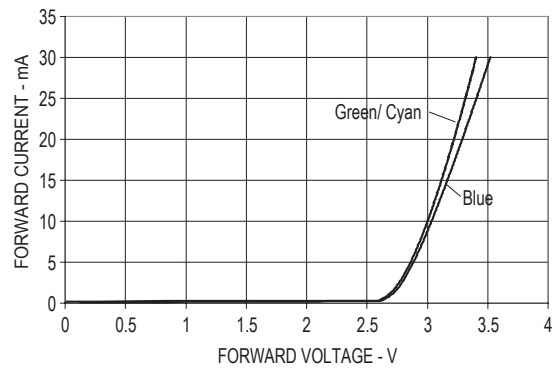


Figure 2 : Forward current vs. forward voltage.

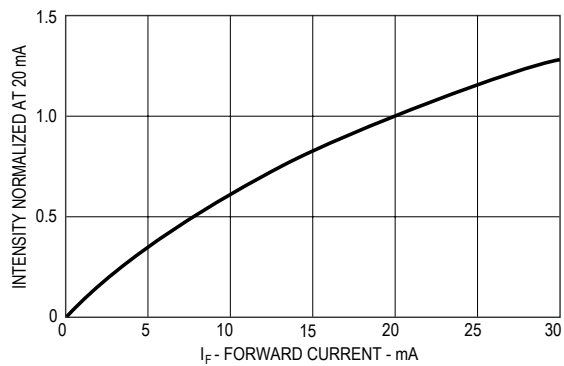


Figure 3. Relative luminous intensity vs. forward current.

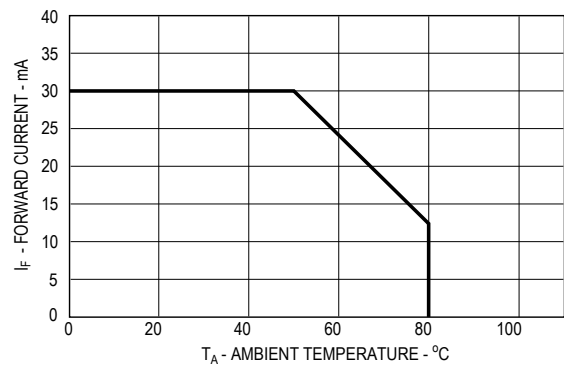


Figure 4. Maximum forward current vs. ambient temperature.

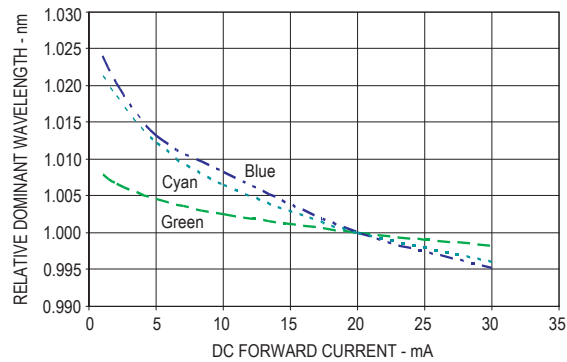


Figure 5. Color vs. forward current

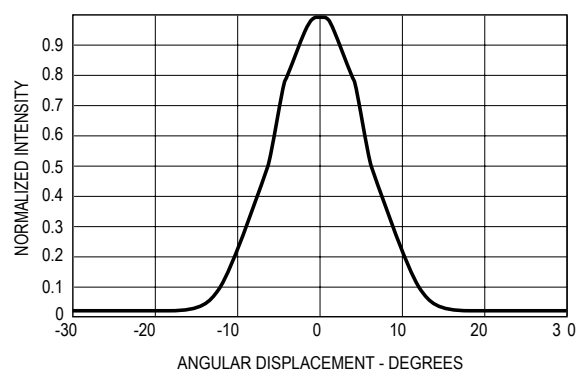


Figure 6. Spatial radiation pattern – 15° lamps.

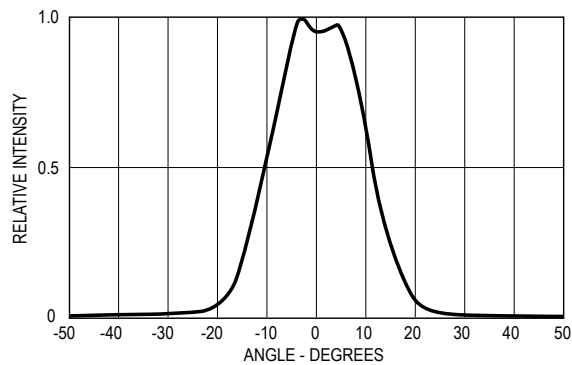


Figure 7. Spatial radiation pattern – 23° lamps.

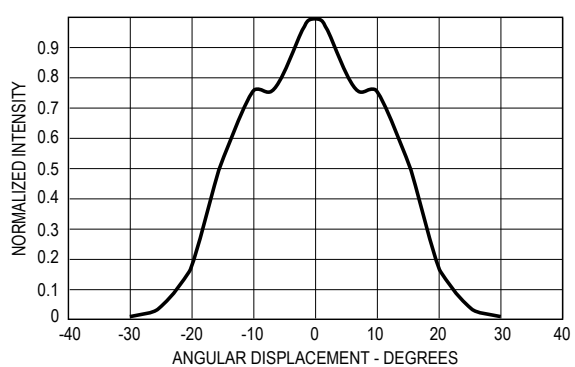


Figure 8. Spatial radiation pattern – 30° lamps.

## Color Bin Limits (nm at 20 mA)

| Blue   | Color Range (nm) |       |
|--------|------------------|-------|
| Bin ID | Min.             | Max.  |
| 1      | 460.0            | 464.0 |
| 2      | 464.0            | 468.0 |
| 3      | 468.0            | 472.0 |
| 4      | 472.0            | 476.0 |
| 5      | 476.0            | 480.0 |

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

| Green  | Color Range (nm at 20mA) |       |
|--------|--------------------------|-------|
| Bin ID | Min.                     | Max.  |
| 1      | 520.0                    | 524.0 |
| 2      | 524.0                    | 528.0 |
| 3      | 528.0                    | 532.0 |
| 4      | 532.0                    | 536.0 |
| 5      | 536.0                    | 540.0 |

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

| Cyan   | Color Range (nm) |      |
|--------|------------------|------|
| Bin ID | Min.             | Max. |
| 1      |                  |      |
| 2      | 495              | 500  |
| 3      | 500              | 505  |
| 4      | 505              | 510  |
| 7      | 498              | 503  |
| 8      | 503              | 508  |

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

## Intensity Bin Limits

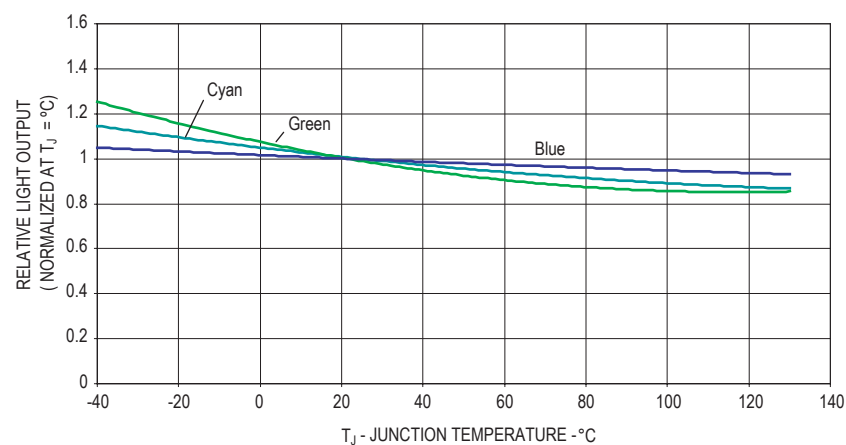
| Bin Name | Min.  | Max.  |
|----------|-------|-------|
| K        | 310   | 400   |
| L        | 400   | 520   |
| M        | 520   | 680   |
| N        | 680   | 880   |
| P        | 880   | 1150  |
| Q        | 1150  | 1500  |
| R        | 1500  | 1900  |
| S        | 1900  | 2500  |
| T        | 2500  | 3200  |
| U        | 3200  | 4200  |
| V        | 4200  | 5500  |
| W        | 5500  | 7200  |
| X        | 7200  | 9300  |
| Y        | 9300  | 12000 |
| Z        | 12000 | 16000 |

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

Note:

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

## Relative Light Output vs. Junction Temperature





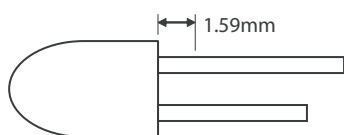
## Precautions:

### Lead Forming:

- The leads of an LED lamp may be performed or cut to length prior to insertion and soldering on PC board.
- If lead forming is required before soldering, care must be taken to avoid any excessive mechanical stress that induced into the LED package. Otherwise, cut the leads to applicable length after soldering process at room temperature. The solder joint formed will absorb the mechanical stress, due to the lead cutting, from traveling to the LED chip die attach and wirebond.
- 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.

### Soldering condition:

- Care must be taken during PCB assembly and soldering process to prevent damage to the LED component.
- The closest manual soldering distance of the soldering heat source (soldering iron's tip) to the body is 1.59mm. Soldering the LED closer than 1.59mm might damage the LED.



- Recommended soldering condition:

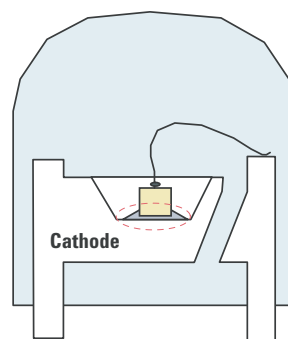
|                      | Wave Soldering | Manual Solder Dipping |
|----------------------|----------------|-----------------------|
| Pre-heat temperature | 105 °C Max.    | -                     |
| Preheat time         | 30 sec Max     | -                     |
| Peak temperature     | 250 °C Max.    | 260 °C Max.           |
| Dwell time           | 3 sec Max.     | 5 sec Max             |

- Wave soldering parameter must be set and maintain according to the recommended temperature and dwell time. Customer is advised to daily check on the soldering profile to ensure that the soldering profile is always conforming to recommended soldering condition.

#### 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 is not exceeding 250°C. 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 material through conductive paste of solder.

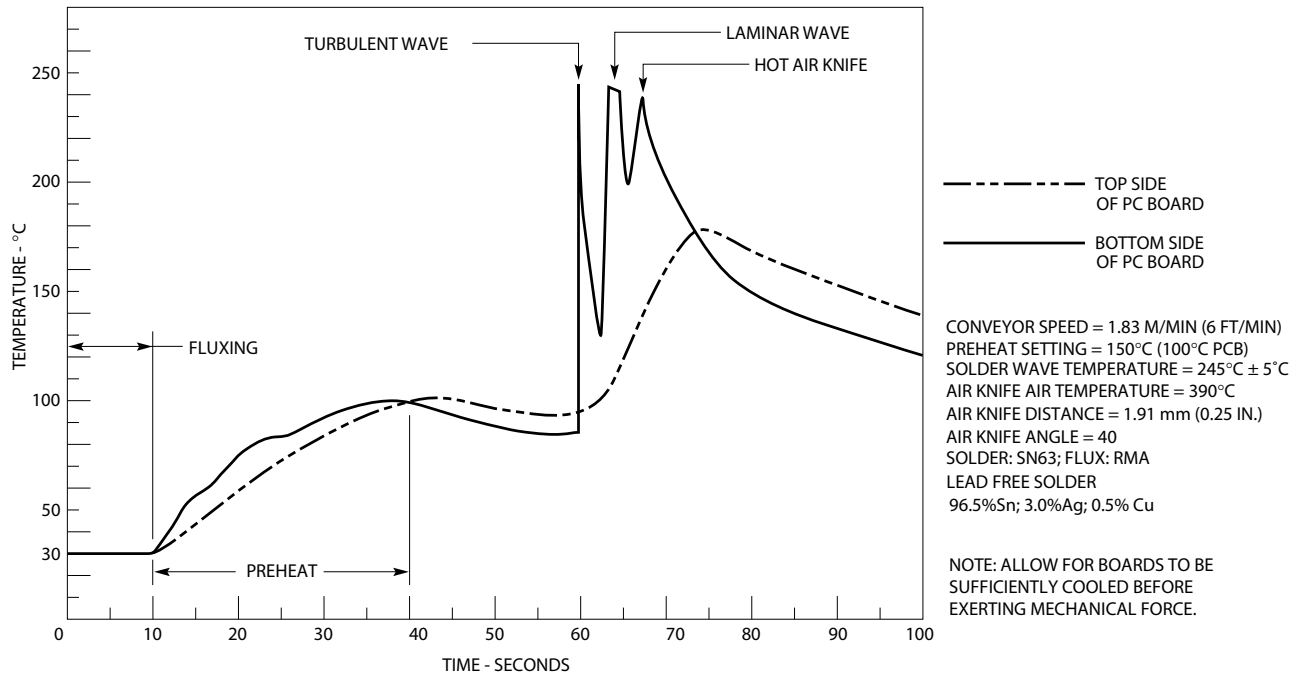
- If necessary, use fixture to hold the LED component in proper orientation with respect to the PCB during soldering process.
- At elevated temperature, the LED is more susceptible to mechanical stress. Therefore, PCB must allowed to cool down to room temperature prior to handling, which includes removal of jigs, fixtures or pallet.
- Special attention must be given to board fabrication, solder masking, surface plating and lead holes size and component orientation to assure the solderability.
- Recommended PC board plated through holes size for LED component leads.

| LED component lead size                  | Diagonal                 | Plated through hole diameter               |
|------------------------------------------|--------------------------|--------------------------------------------|
| 0.457 x 0.457 mm<br>(0.018 x 0.018 inch) | 0.646 mm<br>(0.025 inch) | 0.976 to 1.078 mm<br>(0.038 to 0.042 inch) |
| 0.508 x 0.508 mm<br>(0.020 x 0.020 inch) | 0.718 mm<br>(0.028 inch) | 1.049 to 1.150 mm<br>(0.041 to 0.045 inch) |

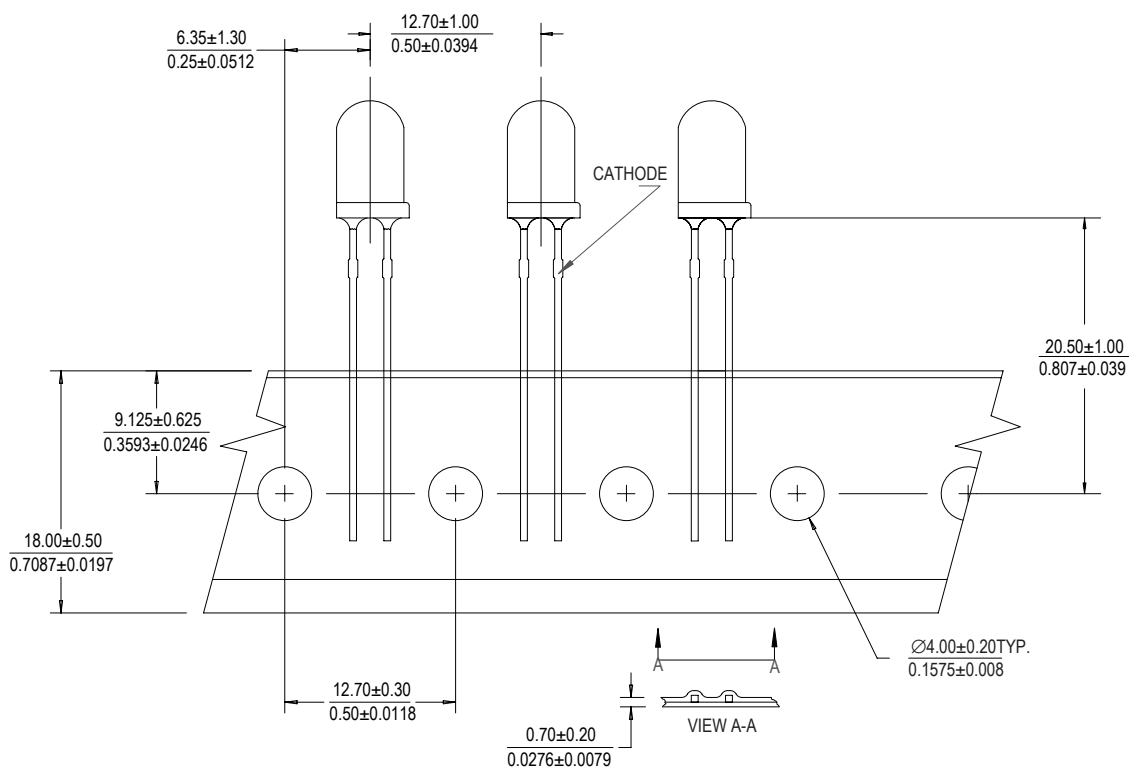
- Over sizing of plated through hole can lead to twisting or improper LED placement during auto insertion. Under sizing plated through hole can lead to mechanical stress on the epoxy lens during clinching.

Note: Refer to application note AN1027 for more information on soldering LED components.

### Recommended Wave Soldering Profile

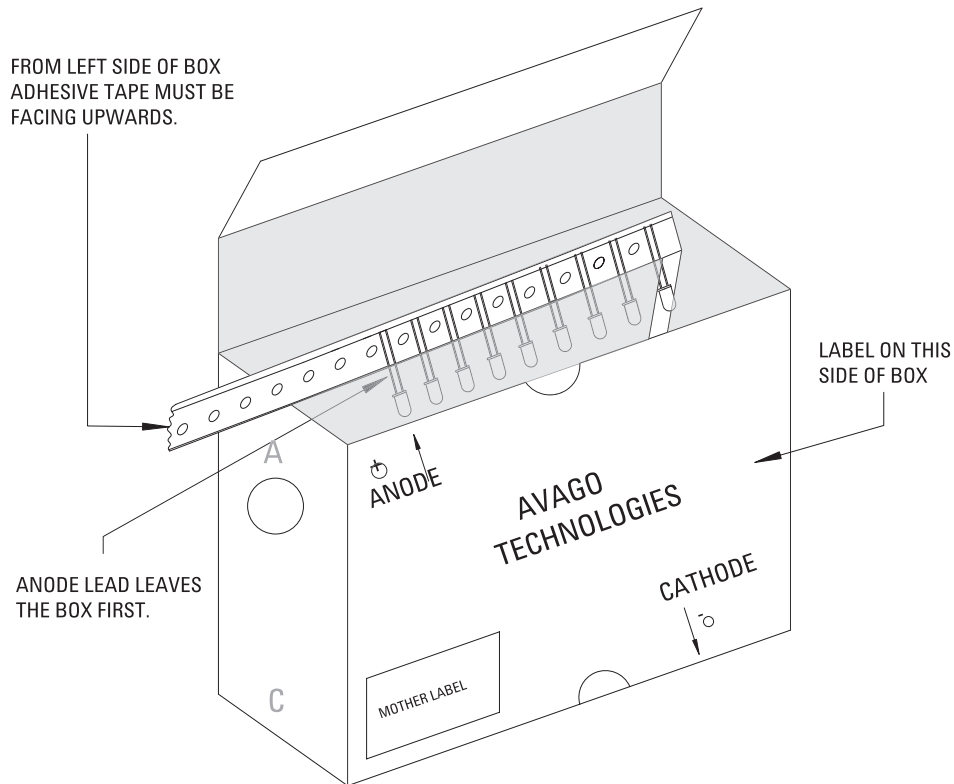


## Ammo Packs Drawing



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

## Packaging Box for Ammo Packs



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

### DISCLAIMER

AVAGO TECHNOLOGIES' PRODUCTS AND SOFTWARE ARE NOT SPECIFICALLY DESIGNED, MANUFACTURED OR AUTHORIZED FOR SALE AS PARTS, COMPONENTS OR ASSEMBLIES FOR THE PLANNING, CONSTRUCTION, MAINTENANCE OR DIRECT OPERATION OF A NUCLEAR FACILITY OR FOR USE IN MEDICAL DEVICES OR APPLICATIONS. CUSTOMER IS SOLELY RESPONSIBLE, AND WAIVES ALL RIGHTS TO MAKE CLAIMS AGAINST AVAGO OR ITS SUPPLIERS, FOR ALL LOSS, DAMAGE, EXPENSE OR LIABILITY IN CONNECTION WITH SUCH USE.

For product information and a complete list of distributors, please go to our web site: [www.avagotech.com](http://www.avagotech.com)

Avago, Avago Technologies, and the A logo are trademarks of Avago Technologies, Limited in the United States and other countries. Data subject to change. Copyright © 2007 Avago Technologies Limited. All rights reserved.  
AV02-0213EN - March 21, 2007

**Avago**  
TECHNOLOGIES