

# HLMP-S100, HLMP-S201, HLMP-S301, HLMP-S400, HLMP-S401, HLMP-S501, HLMP-S600

## 2 mm x 5 mm Rectangular LED Lamps



### Data Sheet



#### Description

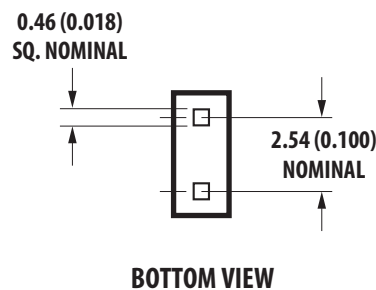
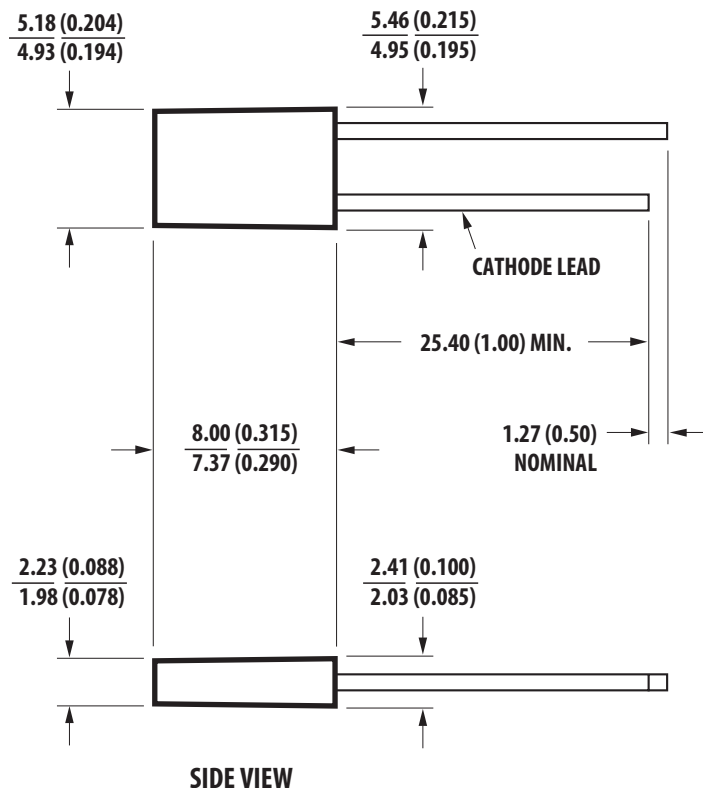
The HLMP-S100, -S201, -S301, -S400, -S401, -S501, -S600 are epoxy encapsulated lamps in rectangular packages which are easily stacked in arrays or used for discrete front panel indicators. Contrast and light uniformity are enhanced by a special epoxy diffusion and tinting process.

The HLMP-S100 uses double heterojunction (DH) absorbing substrate (AS) aluminum gallium arsenide (AlGaAs) LEDs to produce outstanding light output over a wide range of drive currents.

#### Features

- Rectangular light emitting surface
- Excellent for flush mounting on panels
- Choice of five bright colors
- Long life: solid state reliability
- Excellent uniformity of light output

#### Package Dimensions



#### NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS (INCHES).
2. AN EPOXY MENISCUS MAY EXTEND ABOUT 1 mm (0.040") DOWN THE LEADS.
3. THERE IS A MAXIMUM 1 TAPER FROM BASE TO THE TOP OF LAMP.

## Selection Guide

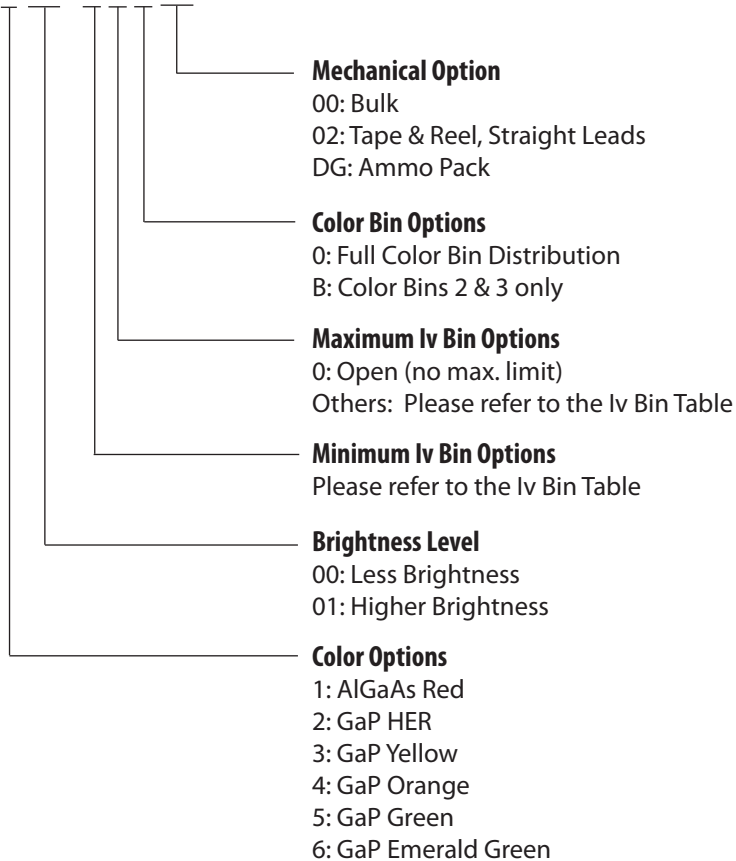
| Color                        | Part Number     | Luminous Intensity Iv (mcd) at 20 mA |      |      |
|------------------------------|-----------------|--------------------------------------|------|------|
|                              |                 | Min.                                 | Typ. | Max. |
| AlGaAs Red                   | HLMP-S100       | 3.4                                  | 7.5  | –    |
| HER                          | HLMP-S201       |                                      |      |      |
|                              | HLMP-S201-D00xx | 2.1                                  | 3.5  | –    |
|                              | HLMP-S201-E00xx | 3.4                                  | 7.5  | –    |
|                              | HLMP-S201-EF0xx | 3.4                                  | 7.5  | 10.8 |
| Orange                       | HLMP-S400       | 2.1                                  | 3.5  | –    |
|                              | HLMP-S401       | 3.4                                  | 7.5  | –    |
| Yellow                       | HLMP-S301       |                                      |      |      |
|                              | HLMP-S301-B00xx | 1.4                                  | 2.1  | –    |
|                              | HLMP-S301-C00xx | 2.2                                  | 4.0  | –    |
|                              | HLMP-S301-CDBxx | 2.2                                  | 4.0  | 7.2  |
| Green                        | HLMP-S501       |                                      |      |      |
|                              | HLMP-S501-C00xx | 2.6                                  | 4.0  | –    |
|                              | HLMP-S501-D00xx | 4.2                                  | 8.0  | –    |
|                              | HLMP-S501-DE0xx | 4.2                                  | 8.0  | 13.4 |
| Emerald Green <sup>[1]</sup> | HLMP-S600-A00xx | 1.0                                  | 3.0  | –    |

Note:

1. Please refer to Application Note 1061 for information comparing standard green and emerald green light output degradation.

## Part Numbering System

HLMP - S x xx - x x x xx



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

| Sym.                     | Description                                           | Device HLMP-                                                                    | Min.                     | Typ.                                   | Max.                     | Units              | Test Conditions                           |
|--------------------------|-------------------------------------------------------|---------------------------------------------------------------------------------|--------------------------|----------------------------------------|--------------------------|--------------------|-------------------------------------------|
| $2\theta_{1/2}$          | Included Angle Between Half Luminous Intensity Points | All                                                                             |                          | 110                                    |                          | Deg.               | $I_F = 20\text{ mA}$<br>See Note 1        |
| $\lambda_{\text{PEAK}}$  | Peak Wavelength                                       | AlGaAs Red<br>High Efficiency Red<br>Orange<br>Yellow<br>Green<br>Emerald Green |                          | 645<br>635<br>600<br>583<br>565<br>558 |                          | nm                 | Measurement at Peak                       |
| $\lambda_d$              | Dominant Wavelength                                   | AlGaAs Red<br>High Efficiency Red<br>Orange<br>Yellow<br>Green<br>Emerald Green |                          | 637<br>626<br>602<br>585<br>569<br>560 |                          | nm                 | See Note 2<br>Time const, $e^{-t/\tau_s}$ |
| $\tau_s$                 | Speed of Response                                     | AlGaAs Red<br>High Efficiency Red<br>Orange<br>Yellow<br>Green<br>Emerald Green |                          | 30<br>90<br>280<br>90<br>500<br>3100   |                          | ns                 |                                           |
| C                        | Capacitance                                           | AlGaAs Red<br>High Efficiency Red<br>Orange<br>Yellow<br>Green<br>Emerald Green |                          | 30<br>11<br>4<br>15<br>18<br>35        |                          | pF                 | $V_F = 0; f = 1\text{ MHz}$               |
| $R\theta_{\text{J-PIN}}$ | Thermal Resistance                                    | All                                                                             |                          | 260                                    |                          | $^\circ\text{C/W}$ | Junction to Cathode Lead at Seating Plane |
| $V_F$                    | Forward Voltage                                       | AlGaAs Red<br>HER/Orange<br>Yellow<br>Green/Emerald<br>Green                    | 1.6<br>1.5<br>1.5<br>1.5 | 1.8<br>1.9<br>2.1<br>2.2               | 2.2<br>2.6<br>2.6<br>3.0 | V                  | $I_F = 20\text{ mA}$                      |
| $V_R$                    | Reverse Breakdown Voltage                             | All                                                                             | 5.0                      |                                        |                          | V                  | $I_R = 100\text{ mA}$                     |
| $\eta_V$                 | Luminous Efficacy                                     | AlGaAs Red<br>High Efficiency Red<br>Orange<br>Yellow<br>Green<br>Emerald Green |                          | 80<br>145<br>380<br>500<br>595<br>656  |                          | lumens/<br>watt    | See Note 3                                |

Notes:

- $\theta_{1/2}$  is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
- The dominant wavelength,  $\lambda_d$ , is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.
- Radiant intensity,  $I_e$ , in watts/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.
- Please refer to Application Note 1061 for information comparing standard green and emerald green light output degradation.

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

| Parameter                                                              | AlGaAs Red  | High Efficiency Red/<br>Orange | Green/<br>Yellow | Emerald Green | Units            |
|------------------------------------------------------------------------|-------------|--------------------------------|------------------|---------------|------------------|
| Peak Forward Current                                                   | 300         | 90                             | 60               | 90            | mA               |
| Average Forward Current <sup>[1]</sup>                                 | 20          | 25                             | 20               | 25            | mA               |
| DC Current <sup>[2]</sup>                                              | 30          | 30                             | 20               | 30            | mA               |
| Transient Forward Current <sup>[3]</sup><br>(10 $\mu\text{sec}$ Pulse) | 500         | 500                            | 500              | 500           | mA               |
| LED Junction Temperature                                               | 110         | 110                            | 110              | 110           | $^\circ\text{C}$ |
| Operating Temperature Range                                            | -20 to +100 | -40 to +100                    | -40 to +100      | -20 to +100   | $^\circ\text{C}$ |
| Storage Temperature Range                                              | -40 to +100 | -40 to +100                    | -40 to +100      | -40 to +100   | $^\circ\text{C}$ |

Notes:

1. See Figure 5 to establish pulsed operating conditions.
2. For AlGaAs Red, Red, Orange, and Green series derate linearly from  $50^\circ\text{C}$  at  $0.5\text{ mA}/^\circ\text{C}$ . For Yellow series derate linearly from  $50^\circ\text{C}$  at  $0.34\text{ mA}/^\circ\text{C}$ .
3. The transient peak current is the maximum non-recurring peak current that can be applied to the device without damaging the LED die and wire bond. It is not recommended that the device be operated at peak currents beyond the peak forward current listed in the Absolute Maximum Ratings.

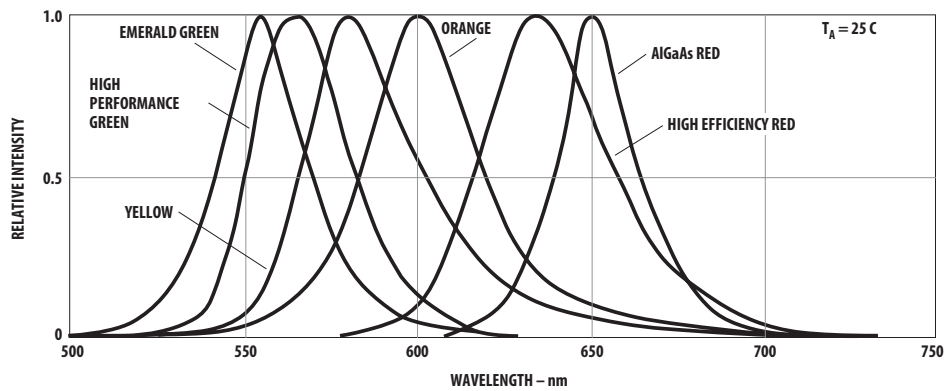


Figure 1. Relative intensity vs. wavelength.

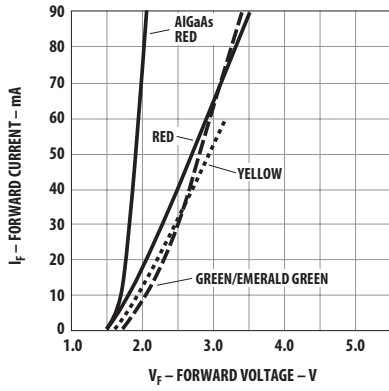


Figure 2. Forward current vs. forward voltage characteristics.  $V_f$  (300 mA) for AlGaAs Red = 2.6 volts typical.

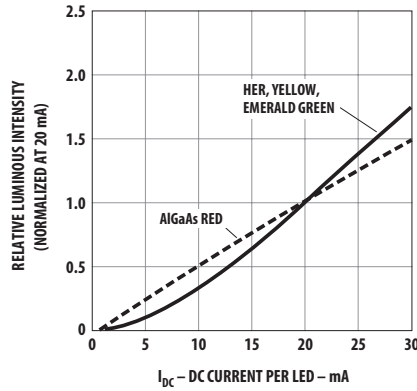


Figure 3. Relative luminous intensity vs. DC forward current.

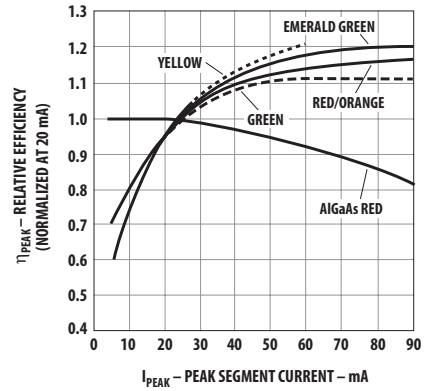


Figure 4. Relative efficiency (luminous intensity per unit current) vs. LED peak current.  $\eta_v$  (300 mA) for AlGaAs Red = 0.7.

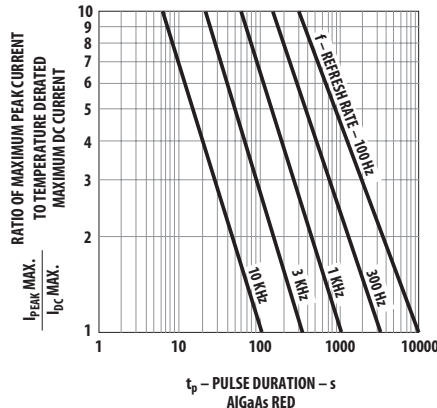
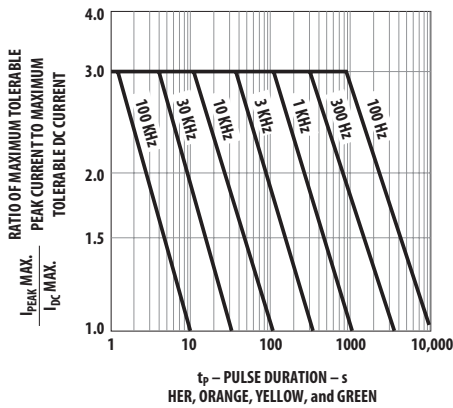


Figure 5. Maximum tolerable peak current vs. peak duration. ( $I_{PEAK\ MAX}$  determined from temperature derated  $I_{DC\ MAX}$ ).

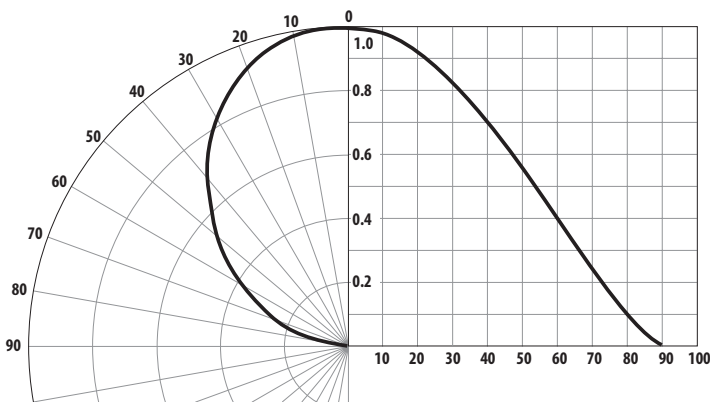


Figure 6. Relative luminous intensity vs. angular displacement.

### Intensity Bin Limits

| Color      | Bin     | Intensity Range (mcd) |         |
|------------|---------|-----------------------|---------|
|            |         | Min.                  | Max.    |
| Red/Orange | D       | 2.4                   | 3.8     |
|            | E       | 3.8                   | 6.1     |
|            | F       | 6.1                   | 9.7     |
|            | G       | 9.7                   | 15.5    |
|            | H       | 15.5                  | 24.8    |
|            | I       | 24.8                  | 39.6    |
|            | J       | 39.6                  | 63.4    |
|            | K       | 63.4                  | 101.5   |
|            | L       | 101.5                 | 162.4   |
|            | M       | 162.4                 | 234.6   |
|            | N       | 234.6                 | 340.0   |
|            | O       | 340.0                 | 540.0   |
|            | P       | 540.0                 | 850.0   |
|            | Q       | 850.0                 | 1200.0  |
|            | R       | 1200.0                | 1700.0  |
|            | S       | 1700.0                | 2400.0  |
|            | T       | 2400.0                | 3400.0  |
|            | U       | 3400.0                | 4900.0  |
|            | V       | 4900.0                | 7100.0  |
|            | W       | 7100.0                | 10200.0 |
| X          | 10200.0 | 14800.0               |         |
| Y          | 14800.0 | 21400.0               |         |
| Z          | 21400.0 | 30900.0               |         |
| Yellow     | B       | 1.6                   | 2.5     |
|            | C       | 2.5                   | 4.0     |
|            | D       | 4.0                   | 6.5     |
|            | E       | 6.5                   | 10.3    |
|            | F       | 10.3                  | 16.6    |
|            | G       | 16.6                  | 26.5    |
|            | H       | 26.5                  | 42.3    |
|            | I       | 42.3                  | 67.7    |
|            | J       | 67.7                  | 108.2   |
|            | K       | 108.2                 | 173.2   |
|            | L       | 173.2                 | 250.0   |
|            | M       | 250.0                 | 360.0   |
|            | N       | 360.0                 | 510.0   |
|            | O       | 510.0                 | 800.0   |
|            | P       | 800.0                 | 1250.0  |
|            | Q       | 1250.0                | 1800.0  |
|            | R       | 1800.0                | 2900.0  |
|            | S       | 2900.0                | 4700.0  |
|            | T       | 4700.0                | 7200.0  |
|            | U       | 7200.0                | 11700.0 |
| V          | 11700.0 | 18000.0               |         |
| W          | 18000.0 | 27000.0               |         |

### Intensity Bin Limits, continued

| Color                   | Bin     | Intensity Range (mcd) |        |
|-------------------------|---------|-----------------------|--------|
|                         |         | Min.                  | Max.   |
| Green/<br>Emerald Green | A       | 1.1                   | 1.8    |
|                         | B       | 1.8                   | 2.9    |
|                         | C       | 2.9                   | 4.7    |
|                         | D       | 4.7                   | 7.6    |
|                         | E       | 7.6                   | 12.0   |
|                         | F       | 12.0                  | 19.1   |
|                         | G       | 19.1                  | 30.7   |
|                         | H       | 30.7                  | 49.1   |
|                         | I       | 49.1                  | 78.5   |
|                         | J       | 78.5                  | 125.7  |
|                         | K       | 125.7                 | 201.1  |
|                         | L       | 201.1                 | 289.0  |
|                         | M       | 289.0                 | 417.0  |
|                         | N       | 417.0                 | 680.0  |
|                         | O       | 680.0                 | 1100.0 |
|                         | P       | 1100.0                | 1800.0 |
|                         | Q       | 1800.0                | 2700.0 |
| R                       | 2700.0  | 4300.0                |        |
| S                       | 4300.0  | 6800.0                |        |
| T                       | 6800.0  | 10800.0               |        |
| U                       | 10800.0 | 16000.0               |        |
| V                       | 16000.0 | 25000.0               |        |
| W                       | 25000.0 | 40000.0               |        |

Maximum tolerance for each bin limit is ±18%.

## Color Categories

| Color         | Category # | Lambda (nm) |       |
|---------------|------------|-------------|-------|
|               |            | Min.        | Max.  |
| Emerald Green | 9          | 552.5       | 555.5 |
|               | 8          | 555.5       | 558.5 |
|               | 7          | 558.5       | 561.5 |
|               | 6          | 561.5       | 564.5 |
| Green         | 6          | 561.5       | 564.5 |
|               | 5          | 564.5       | 567.5 |
|               | 4          | 567.5       | 570.5 |
|               | 3          | 570.5       | 573.5 |
|               | 2          | 573.5       | 576.5 |
|               | 1          | 582.0       | 584.5 |
| Yellow        | 3          | 584.5       | 587.0 |
|               | 2          | 587.0       | 589.5 |
|               | 4          | 589.5       | 592.0 |
|               | 5          | 592.0       | 593.0 |
| Orange        | 1          | 597.0       | 599.5 |
|               | 2          | 599.5       | 602.0 |
|               | 3          | 602.0       | 604.5 |
|               | 4          | 604.5       | 607.5 |
|               | 5          | 607.5       | 610.5 |
|               | 6          | 610.5       | 613.5 |
|               | 7          | 613.5       | 616.5 |
|               | 8          | 616.5       | 619.5 |

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

## Mechanical Option Matrix

| Mechanical Option Code | Definition                                                  |
|------------------------|-------------------------------------------------------------|
| 00                     | Bulk Packaging, minimum increment 500 pcs/bag               |
| 02                     | Tape & Reel, straight leads, minimum increment 1300 pcs/bag |
| DG                     | Ammo Pack, straight leads with minimum increment 2K/pack    |

Note:

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

## Precautions

### Lead Forming

- The leads of an LED lamp may be preformed or cut to length prior to insertion and soldering into PC board.
- If lead forming is required before soldering, care must be taken to avoid any excessive mechanical stress induced to LED package. Otherwise, cut the leads of LED to length after soldering process at room temperature. The solder joint formed will absorb the mechanical stress of the lead cutting from traveling to the LED chip die attach and wirebond.
- It is recommended that tooling made to precisely form and cut the leads to length rather than rely upon hand operation.

### Soldering Conditions

- Care must be taken during PCB assembly and soldering process to prevent damage to LED component.
- The closest LED is allowed to solder on board is 1.59 mm below the body (encapsulant epoxy) for those parts without standoff.
- Recommended soldering conditions:

|                      | Wave Soldering | Manual Solder Dipping |
|----------------------|----------------|-----------------------|
| Pre-heat Temperature | 105°C Max.     | –                     |
| Pre-heat 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 maintained according to recommended temperature and dwell time in the solder wave. Customer is advised to periodically check on the soldering profile to ensure the soldering profile used is always conforming to recommended soldering condition.
- If necessary, use fixture to hold the LED component in proper orientation with respect to the PCB during soldering process.
- Proper handling is imperative to avoid excessive thermal stresses to LED components when heated. Therefore, the soldered PCB must be allowed to cool to room temperature, 25°C, before handling.
- Special attention must be given to board fabrication, solder masking, surface plating and lead holes size and component orientation to assure solderability.
- Recommended PC board plated through hole sizes 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) |

Note:

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

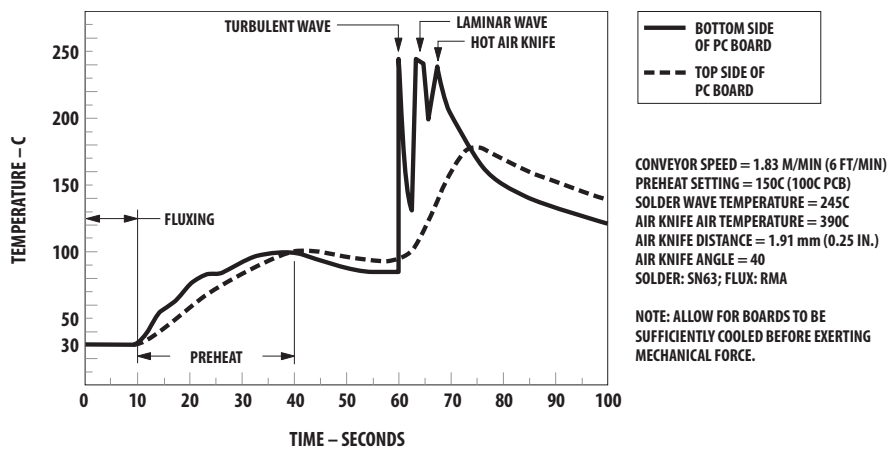


Figure 7. Recommended wave soldering profile.

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