



THE DATASHEET OF HLMP-3850



**HLMP-3707, HLMP-3807, HLMP-3907, HLMP-3750,
HLMP-3850, HLMP-3950, HLMP-3960, HLMP-3390,
HLMP-3490, HLMP-3590, HLMP-1340, HLMP-1440,
HLMP-1540, HLMP-D640, HLMP-K640**
T-13/4 (5 mm), T-1 (3 mm), Ultra-Bright LED Lamps



Data Sheet



Description

These non-diffused lamps out-perform conventional LED lamps. By utilizing new higher intensity material, we achieve superior product performance.

The HLMP-3750/-3390/-1340 Series Lamps are Gallium Arsenide Phosphide on Gallium Phosphide red light emitting diodes. The HLMP-3850/-3490/-1440 Series are Gallium Arsenide Phosphide on Gallium Phosphide yellow light emitting diodes. The HLMP-3950/-3590/-3960/-1540/-D640/-K640 Series Lamps are Gallium Phosphide green light emitting diodes.

Features

- Improved brightness
- Improved color performance
- Available in popular T-1 and T-1³/₄ packages
- New sturdy leads
- IC compatible/low current capability
- Reliable and rugged
- Choice of 3 bright colors
High Efficiency Red
High Brightness Yellow
High Performance Green

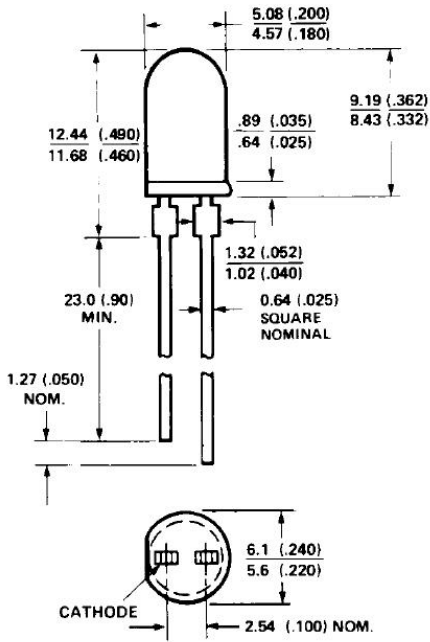
Applications

- Lighted switches
- Backlighting front panels
- Light pipe sources
- Keyboard indicators

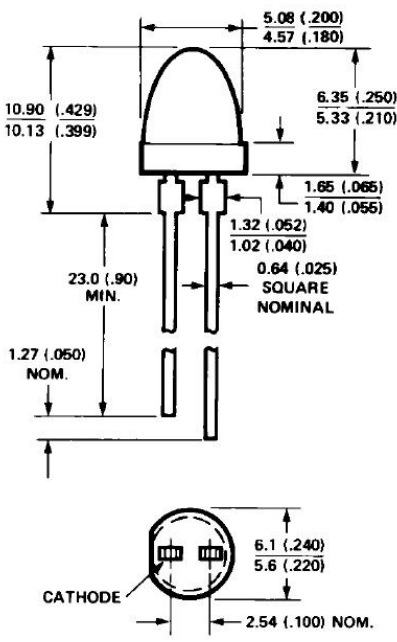
Selection Guide

| Package Description | Color | Luminous Intensity Iv (mcd) @ 20mA | | | | 2q1/2 Degree | Package Outline |
|---------------------|--------------------------------|------------------------------------|-------|-------|-------|--------------|-----------------|
| | | Device HLMP- | Min. | Typ. | Max. | | |
| T-1 ^{3/4} | Red | 3707-L00xx | 90.2 | - | - | 24 | F |
| | | 3750 | 90.2 | 125.0 | - | 24 | A |
| | | 3750-L00xx | 90.2 | 125.0 | - | 24 | A |
| | Yellow | 3807-K00xx | 96.2 | - | - | 24 | F |
| | | 3850 | 96.2 | 140.0 | - | 24 | A |
| | | 3850-K00xx | 96.2 | 140.0 | - | 24 | A |
| | | 3850-KL0xx | 96.2 | 150.0 | 294.0 | 24 | A |
| | Green | 3907-K00xx | 111.7 | - | - | 24 | F |
| | | 3914-K00xx | 111.7 | - | - | 24 | D |
| | | 3950 | 111.7 | 265.0 | - | 24 | A |
| | | 3950-K00xx | 111.7 | 265.0 | - | 24 | A |
| | | 3950-LM0xx | 170.0 | 300.0 | 490.0 | 24 | A |
| | | 3960-K0xxx | 111.7 | 265.0 | - | 24 | E |
| | Emerald Green | D640-E00xx | 6.7 | 21.0 | - | 24 | D |
| | T-1 ^{3/4} Low Profile | Red | 3390 | 35.2 | 55.0 | - | 32 |
| Yellow | | 3490 | 37.6 | 55.0 | - | 32 | B |
| | | 3490-I00xx | 37.6 | 55.0 | - | 32 | B |
| Green | | 3590 | 43.6 | 55.0 | - | 32 | B |
| | | 3590-I00xx | 43.6 | 55.0 | - | 32 | B |
| T-1 | Red | 1340 | 35.2 | 55.0 | - | 45 | C |
| | | 1340-H00xx | 8.6 | 15.0 | 27.6 | 45 | C |
| | | 1340-J00xx | 35.2 | 55.0 | - | 45 | C |
| | | 1340-JK0xx | 35.2 | 55.0 | 112.8 | 45 | C |
| | Yellow | 1440 | 23.5 | 45.0 | - | 45 | C |
| | | 1440-H00xx | 23.5 | 45.0 | - | 45 | C |
| | | 1440-HI0xx | 23.5 | - | 75.2 | 45 | C |
| | | 1440-HIB00 | 23.5 | - | 75.2 | 45 | C |
| | Green | 1540 | 27.3 | 45.0 | - | 45 | C |
| | | 1540-H00xx | 27.3 | 45.0 | - | 45 | C |
| | | 1540-IJ0xx | 43.6 | 60.0 | 139.6 | 45 | C |
| | Emerald Green | K640 | 4.2 | 21.0 | - | 45 | C |
| | | K640-D00xx | 4.2 | 21.0 | - | 45 | C |
| | | K640-FGNxx | 10.6 | 20.0 | 34.0 | 45 | C |

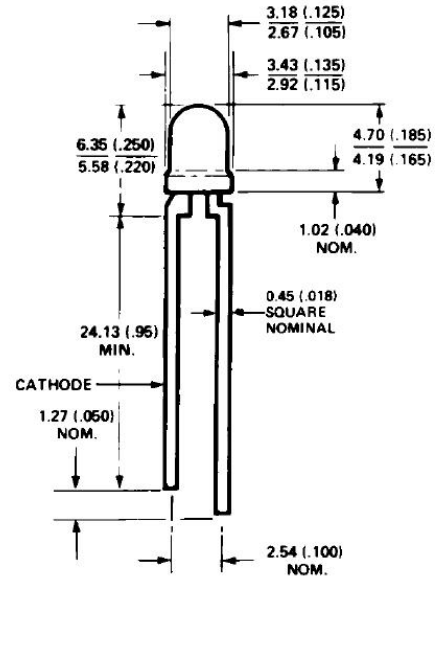
Package Dimensions



PACKAGE OUTLINE "A"
HLMP-3750, -3850, -3950

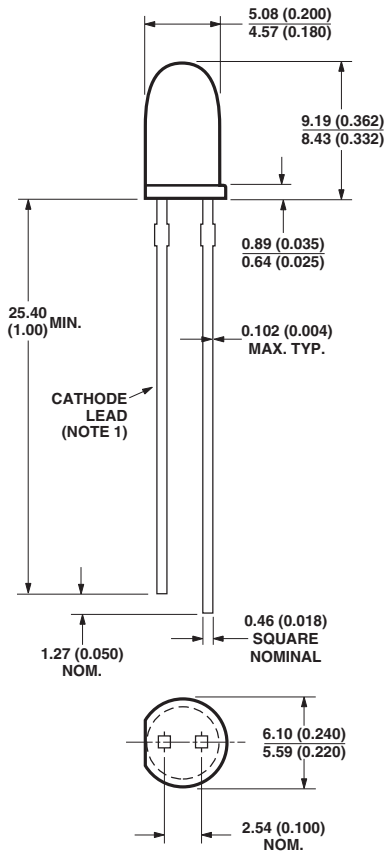


PACKAGE OUTLINE "B"
HLMP-3390, -3490, -3590

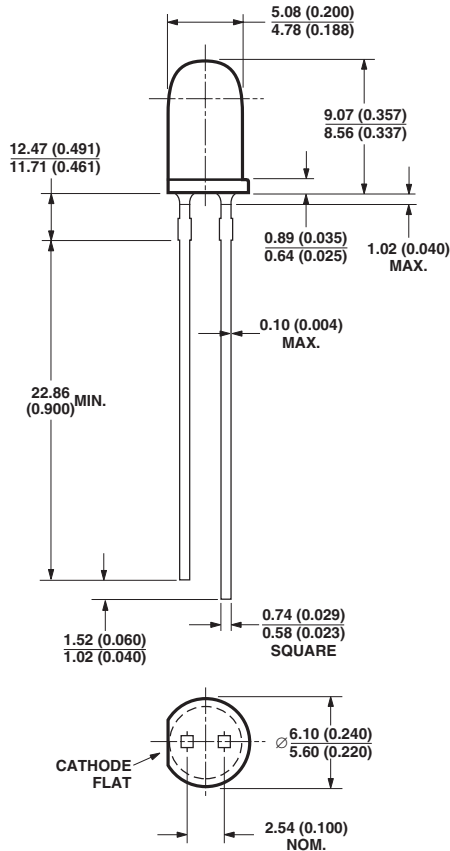


PACKAGE OUTLINE "C"
HLMP-1340, -1440, -1540

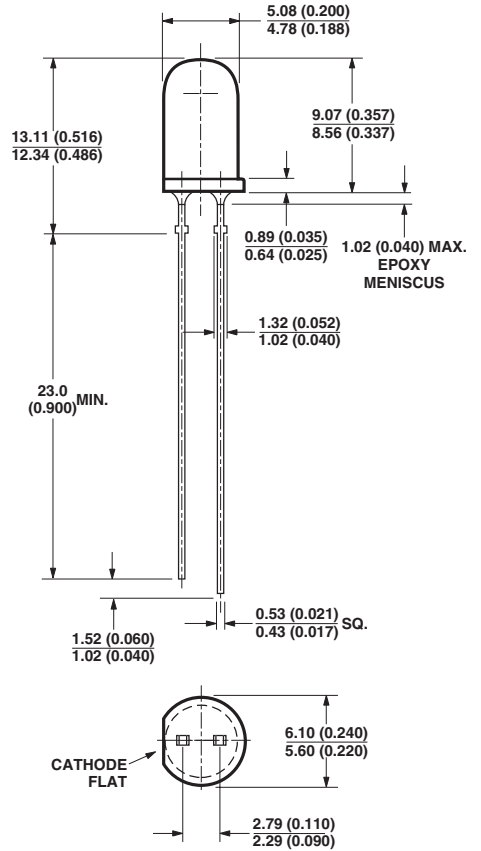
NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS (INCHES).
2. AN EPOXY MENISCUS MAY EXTEND ABOUT 1 mm (0.040") DOWN THE LEADS.



PACKAGE OUTLINE "D"
HLMP-D640



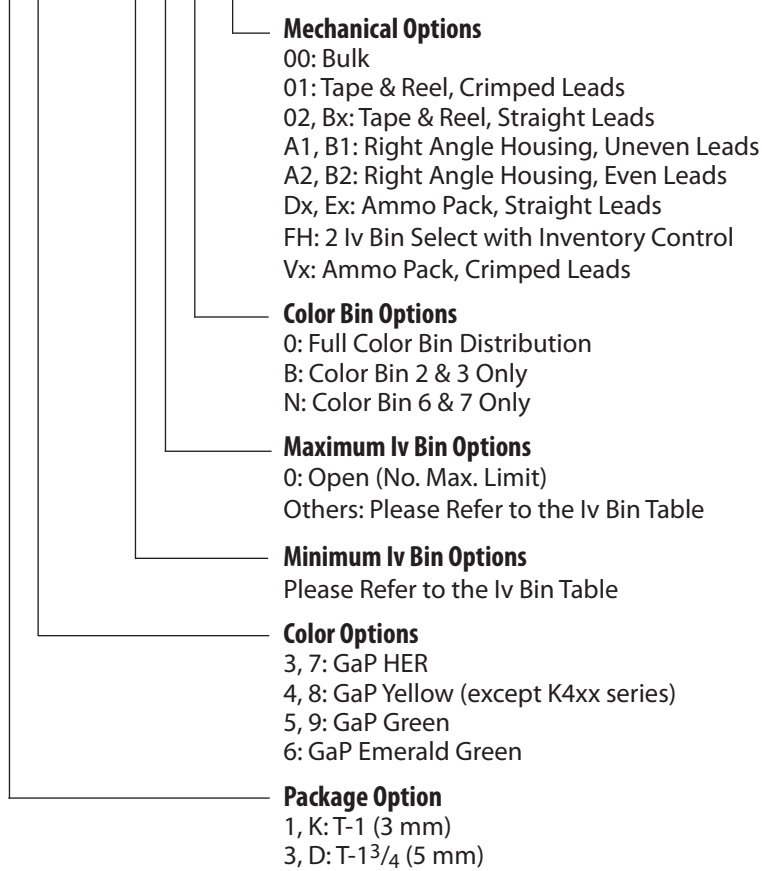
PACKAGE OUTLINE "E"
HLMP-3960



PACKAGE OUTLINE "F"
HLMP-3707/-3807/-3907

Part Numbering System

HLMP - x x xx - x x x xx



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

| Parameter | Red | Yellow | Green/Emerald Green | Units |
|--|-------------|-------------|---------------------|------------------|
| Peak Forward Current | 90 | 60 | 90 | mA |
| Average Forward Current ^[1] | 25 | 20 | 25 | mA |
| DC Current ^[2] | 30 | 20 | 30 | mA |
| Transient Forward Current ^[3] (10 μs Pulse) | 500 | 500 | 500 | mA |
| Reverse Voltage ($I_R = 100 \mu\text{A}$) | 5 | 5 | 5 | V |
| LED Junction Temperature | 110 | 110 | 110 | $^\circ\text{C}$ |
| Operating Temperature Range | -40 to +100 | -40 to +100 | -20 to +100 | $^\circ\text{C}$ |
| Storage Temperature Range | -40 to +100 | -40 to +100 | -40 to +100 | $^\circ\text{C}$ |

Notes:

- See Figure 2 to establish pulsed operating conditions.
- For Red and Green series derate linearly from 50°C at $0.5 \text{ mA}/^\circ\text{C}$. For Yellow series derate linearly from 50°C at $0.2 \text{ mA}/^\circ\text{C}$.
- The transient peak current is the maximum non-recurring peak current the devices can withstand without damaging the LED die and wire bonds. It is not recommended that the device be operated at peak currents beyond the Absolute Maximum Peak Forward Current.

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

| Symbol | Description | T-1 ^{3/4} | T-1 ^{3/4} Low Dome | T-1 | Min. | Typ. | Max. | Units | Test Conditions |
|--------------------------|---------------------------|--------------------|--------------------------------|------|------|------|------|-----------------------|-------------------------------------|
| λ_{PEAK} | Peak Wavelength | 37xx | 3390 | 1340 | | 635 | | nm | Measurement at Peak |
| | | 38xx | 3490 | 1440 | | 583 | | | |
| | | 39xx | 3590 | 1540 | | 565 | | | |
| | | D640 | | K640 | | 558 | | | |
| λ_d | Dominant Wavelength | 37xx | 3390 | 1340 | | 626 | | nm | Note 1 |
| | | 38xx | 3490 | 1440 | | 585 | | | |
| | | 39xx | 3590 | 1540 | | 569 | | | |
| | | D640 | | K640 | | 560 | | | |
| $\Delta\lambda^{3/4}$ | Spectral Line Halfwidth | 37xx | 3390 | 1340 | | 40 | | nm | |
| | | 38xx | 3490 | 1440 | | 36 | | | |
| | | 39xx | 3590 | 1540 | | 28 | | | |
| | | D640 | | K640 | | 24 | | | |
| τ_s | Speed of Respond | 37xx | 3390 | 1340 | | 90 | | ns | |
| | | 38xx | 3490 | 1440 | | 90 | | | |
| | | 39xx | 3590 | 1540 | | 500 | | | |
| | | D640 | | K640 | | 3100 | | | |
| C | Capacitance | 37xx | 3390 | 1340 | | 11 | | pF | $V_F = 0,$ $f = 1 \text{ MHz}$ |
| | | 38xx | 3490 | 1440 | | 15 | | | |
| | | 39xx | 3590 | 1540 | | 18 | | | |
| | | D640 | | K640 | | 35 | | | |
| $R\theta_{\text{J-PIN}}$ | Thermal Resistance | 37xx | 3390 | | | 210 | | $^\circ\text{C/W}$ | Junction to Cathode Lead |
| | | 38xx | 3490 | | | 210 | | | |
| | | 39xx | 3590 | | | 210 | | | |
| | | D640 | | | | 510 | | | |
| | | | | | 1340 | 290 | | | |
| | | | | | 1440 | 290 | | | |
| | | | | | 1540 | 290 | | | |
| | | | | | K640 | 290 | | | |
| V_F | Forward Voltage | 37xx | 3390 | 1340 | 1.5 | 1.9 | 2.6 | V | $I_F = 20 \text{ mA}$ (Figure 3) |
| | | 38xx | 3490 | 1440 | 1.5 | 2.1 | 2.6 | | |
| | | 39xx | 3590 | 1540 | 1.5 | 2.2 | 3.0 | | |
| | | D640 | | K640 | | 2.2 | 3.0 | | |
| V_R | Reverse Breakdown Voltage | 37xx | 3390 | 1340 | 5.0 | | | V | $I_F = 100 \mu\text{A}$ |
| | | 38xx | 3490 | 1440 | | | | | |
| | | 39xx | 3590 | 1540 | | | | | |
| | | D640 | | K640 | | | | | |
| η_V | Luminous Efficacy | 37xx | 3390 | 1340 | | 145 | | <u>lumens</u> watt | Note 2 |
| | | 38xx | 3490 | 1440 | | 500 | | | |
| | | 39xx | 3590 | 1540 | | 595 | | | |
| | | D640 | | K640 | | 655 | | | |

Notes:

1. The dominant wavelength, λ_d , is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.
2. The radiant intensity, I_e , in watts per steradian, may be found from the equation $I_e = IV/\eta_V$, where IV is the luminous intensity in candelas and η_V is the luminous efficacy in lumens/watt.

Red, Yellow, and Green

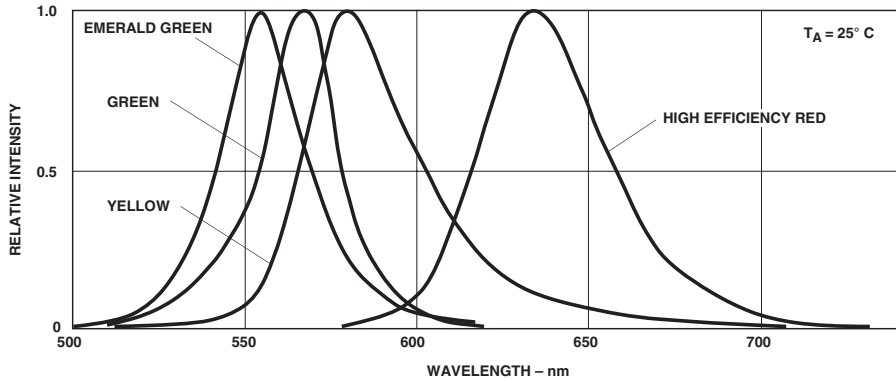


Figure 1. Relative intensity vs. wavelength.

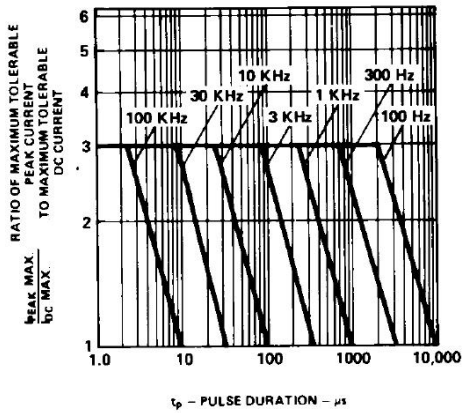


Figure 2. Maximum tolerable peak current vs. pulse duration. (I_{DC} MAX as per MAX ratings).

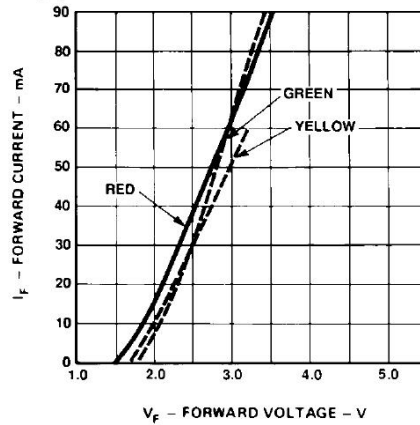


Figure 3. Forward current vs. forward voltage.

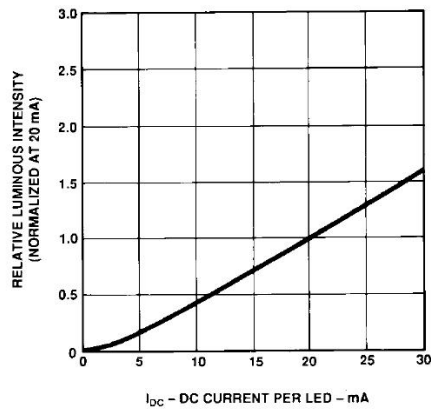


Figure 4. Relative luminous intensity vs. forward current.

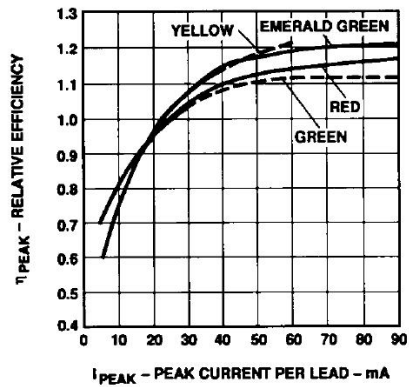


Figure 5. Relative efficiency (luminous intensity per unit current) vs. peak current.

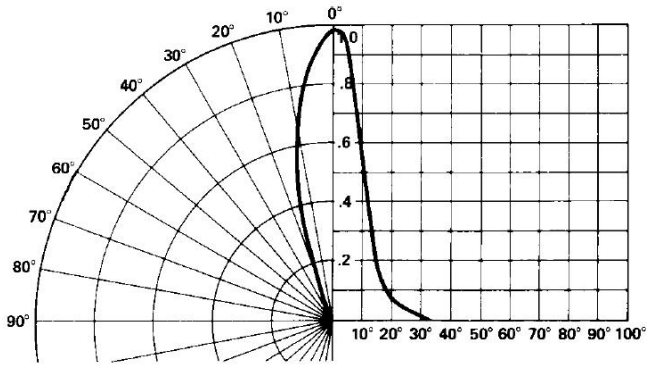


Figure 6. Relative luminous intensity vs. angular displacement. T-1^{3/4} lamp.

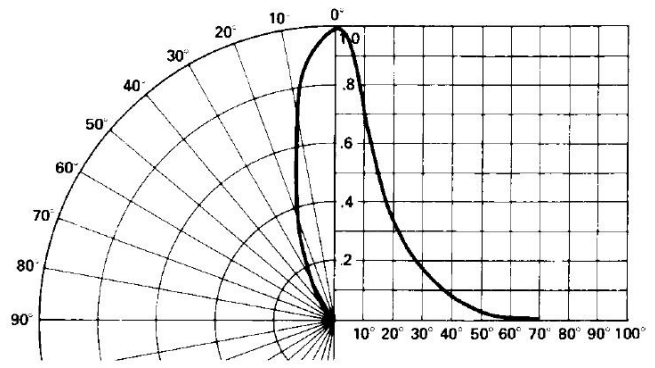


Figure 7. Relative luminous intensity vs. angular displacement. T-1^{3/4} low profile lamp.

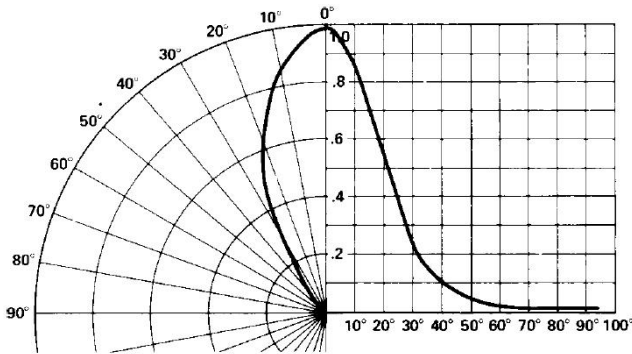


Figure 8. Relative luminous intensity vs. angular displacement. T-1 lamp.

Intensity Bin Limits

| Color | Bin | Intensity Range (mcd) | |
|-------|---------|-----------------------|--------|
| | | Min. | Max. |
| Red | 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 | |

Maximum tolerance for each bin limit is $\pm 18\%$.

Intensity Bin Limits (continued)

| Color | Bin | Intensity Range (mcd) | | |
|--------|-------------------|-----------------------|---------|-----|
| | | Min. | Max. | |
| Yellow | 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 | |
| | Green/ Emerald | A | 1.1 | 1.8 |
| | | B | 1.8 | 2.9 |
| | Green | 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 $\pm 18\%$.

Color Categories

| Color | Cat # | 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 |
| Yellow | 1 | 582.0 | 584.5 |
| | 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 |

Maximum tolerance for each bin limit is ± 0.5 nm.

Mechanical Option Matrix

| Mechanical Option Code | Definition |
|------------------------|--|
| 00 | Bulk Packaging, minimum increment 500 pcs/bag |
| 01 | Tape & Reel, crimped leads, min. increment 1300 pcs/bag for T-1 ^{3/4} , 1800 pcs/bag for T-1 |
| 02 | Tape & Reel, straight leads, min. increment 1300 pcs/bag for T-1 ^{3/4} , 1800 pcs/bag for T-1 |
| A1 | T-1, Right Angle Housing, uneven leads, minimum increment 500 pcs/bag |
| A2 | T-1, Right Angle Housing, even leads, minimum increment 500 psc/bag |
| B1 | T-1 ^{3/4} , Right Angle Housing, uneven leads, minimum increment 500 pcs/bag |
| B2 | T-1 ^{3/4} , Right Angle Housing, even leads, minimum increment 500 psc/bag |
| BJ | T-1, Tape & Reel, straight leads, minimum increment 2000 pcs/bag |
| EG | Ammo Pack, straight leads in 5 K increment |
| FH | Devices that require inventory control and 2 l _v bin select |
| VR | Ammo Pack, crimped leads, min. increment 2 k for T-1 ^{3/4} and T-1 |

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 | Dipping | Manual Solder |
|----------------------|-------------|---------------|
| 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 (0.018 x 0.018 inch) | 0.646 mm (0.025 inch) | 0.976 to 1.078 mm (0.038 to 0.042 inch) |
| 0.508 x 0.508 mm (0.020 x 0.020 inch) | 0.718 mm (0.028 inch) | 1.049 to 1.150 mm (0.041 to 0.045 inch) |

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

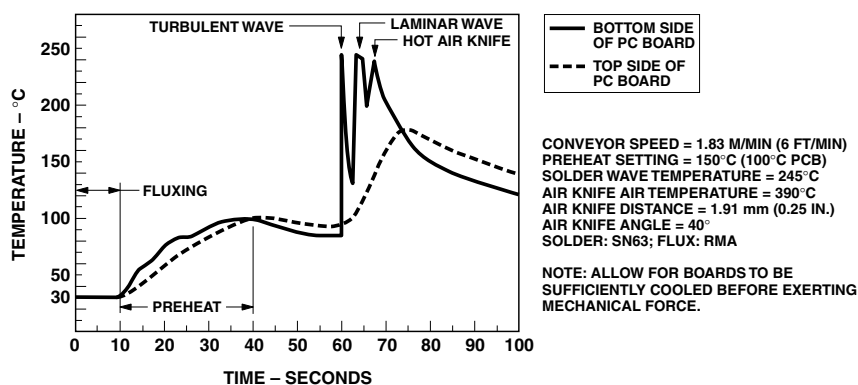


Figure 8. Recommended wave soldering profile.

For product information and a complete list of distributors, please go to our web site: www.avagotech.com

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