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# HLMP-331x, HLMP-341x, HLMP-351x Series

T-1 3/4 (5 mm) High Intensity LED Lamps

## Data Sheet



### Description

This family of T-1 3/4 nondiffused LED lamps is specially designed for applications requiring higher on-axis intensity than is achievable with a standard lamp. The light generated is focused to a narrow beam to achieve this effect.

### Features

- High intensity
- Choice of 3 bright colors
  - High Efficiency Red
  - Yellow
  - High Performance Green
- Popular T-1 3/4 diameter package
- Selected minimum intensities
- Narrow viewing angle
- General purpose leads
- Reliable and rugged
- Available on tape and reel

### Selection Guide

| Color | Part Number | Luminous Intensity Iv (mcd) @ 10 mA Min. | Max. |
|---|---|---|---|
| Red | HLMP-3316 | 22.00 | - |
| | HLMP-3316-I00xx | 22.0 | - |
| Yellow | HLMP-3416 | 14.7 | - |
| Green | HLMP-3519 | 10.6 | - |
| | HLMP-3519-F00xx | 10.6 | - |

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## Part Numbering System

HLMP - 3 x 1 x - x x x xx

**Mechanical Options**
00: Bulk
01: Tape & Reel, Crimped Leads
02: Tape & Reel, Straight Leads
B1: Right Angle Housing, Uneven Leads
B2: Right Angle Housing, Even Leads

**Color Bin Options**
0: Full Color Bin Distribution

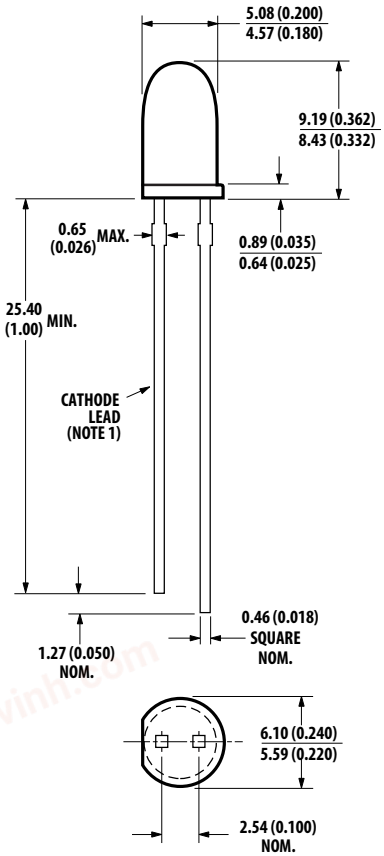
**Maximum Iv Bin Options**
0: Open (no max. limit)
Others: Please refer to the Iv Bin Table

**Minimum Iv Bin Options**
Please refer to the Iv Bin Table

**Brightness Level**
6, 9: Higher Brightness

**Color Options**
3: GaP HER
4: GaP Yellow
5: GaP Green

## Package Dimensions




Notes:
1. All dimensions are in millimeters (inches).
2. An epoxy meniscus may extend about 1 mm (0.40") down the leads.
3. For PCB hole recommendations, see the Precautions section.

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## Electrical Characteristics at $T_A = 25°C$

| Symbol | Description | Device HLMP- | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|---|
| $I_V$ | Luminous Intensity | 3316 | 22 | 60.0 | | mcd | $I_F$ = 10 mA (Figure 3) |
| | | 3416 | 14.7 | 50.0 | | mcd | $I_F$ = 10 mA (Figure 8) |
| | | 3519 | 10.6 | 70.0 | | mcd | $I_F$ = 10 mA (Figure 13) |
| $2\theta^1/_2$ | Including Angle Between Half Luminous Intensity Points | 3316 | | 35 | | Deg. | $I_F$ = 10 mA See Note 1 (Figure 6) |
| | | 3416 | | 35 | | Deg. | $I_F$ = 10 mA See Note 1 (Figure 11) |
| | | 3519 | | 24 | | Deg. | $I_F$ = 10 mA See Note 1 (Figure 16) |
| $\lambda_{PEAK}$ | Peak Wavelength | 331X<br>341X<br>351X | | 635<br>583<br>565 | | nm | Measurement at Peak (Figure 1) |
| $\Delta\lambda_{1/2}$ | Spectral Line Halfwidth | 331X<br>341X<br>351X | | 40<br>36<br>28 | | nm | |
| $\lambda_d$ | Dominant Wavelength | 331X<br>341X<br>351X | | 626<br>585<br>569 | | nm | See Note 2 (Figure 1) |
| $\tau_s$ | Speed of Response | 331X<br>341X<br>351X | | 90<br>90<br>500 | | ns | |
| C | Capacitance | 331X<br>341X<br>351X | | 11<br>15<br>18 | | pF | $V_F$ = 0; f = 1 MHz |
| $R\theta_{J\text{-}PIN}$ | Thermal Resistance | 331X<br>341X<br>351X | | 260 | | °C/W | Junction to Cathode Lead |
| $V_F$ | Forward Voltage | 331X<br>341X<br>351X | | 1.9<br>2.0<br>2.1 | 2.4<br>2.4<br>2.7 | V | $I_F$ = 10 mA (Figure 2)<br>$I_F$ = 10 mA (Figure 7)<br>$I_F$ = 10 mA (Figure 12) |
| $V_R$ | Reverse Breakdown Volt. | All | 5.0 | | | V | $I_R$ = 100 µA |
| $\eta_V$ | Luminous Efficacy | 331X<br>341X<br>351X | | 145<br>500<br>595 | | $\frac{\text{lumens}}{\text{Watt}}$ | See Note 3 |

**Notes:**

1. $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
2. The dominant wavelength, $\lambda_d$, is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.
3. 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.

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## Absolute Maximum Ratings at $T_A = 25°C$

| Parameter | 331X Series | 341X Series | 351X Series | Units |
|---|---|---|---|---|
| Peak Forward Current | 90 | 60 | 90 | mA |
| Average Forward Current[1] | 25 | 20 | 25 | mA |
| DC Current[2] | 30 | 20 | 30 | mA |
| Power Dissipation[3] | 135 | 85 | 135 | mW |
| Reverse Voltage ($I_R$ = 100 µA) | 5 | 5 | 5 | V |
| Transient Forward Current[4] (10 µsec Pulse) | 500 | 500 | 500 | mA |
| LED Junction Temperature | 110 | 110 | 110 | °C |
| Operating Temperature Range | -40 to +100 | -40 to +100 | -20 to +100 | °C |
| Storage Temperature Range | -40 to +100 | -40 to +100 | -40 to +100 | °C |

**Notes:**

1. See Figure 5 (Red), 10 (Yellow), or 15 (Green) to establish pulsed operating conditions.
2. For Red and Green series derate linearly from 50°C at 0.5 mA/°C. For Yellow series derate linearly from 50°C at 0.2 mA/°C.
3. For Red and Green series derate power linearly from 25°C at 1.8 mW/°C. For Yellow series derate power linearly from 50°C at 1.6 mW/°C.
4. The transient peak current is the maximum non-recurring peak current that can be applied to the device without damaging the LED die and wirebond. It is not recommended that the device be operated at peak currents beyond the peak forward current listed in the Absolute Maximum Ratings.

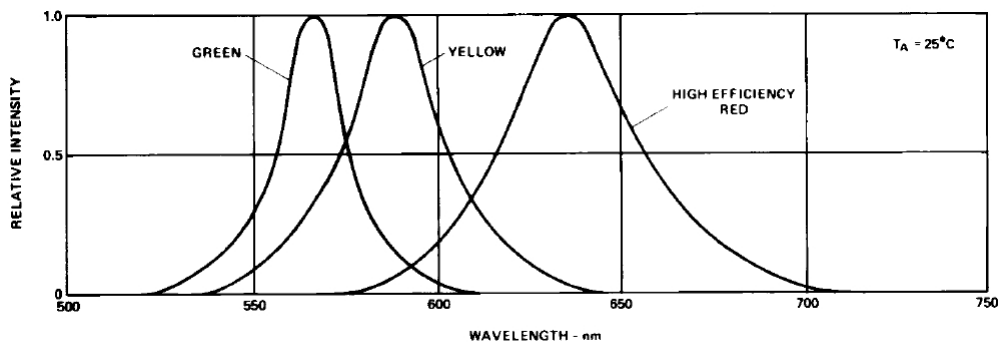



**Figure 1. Relative intensity vs. wavelength.**

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## High Efficiency Red HLMP-331X Series

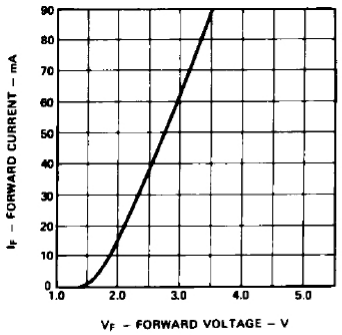



Figure 2. Forward current vs. forward voltage characteristics.

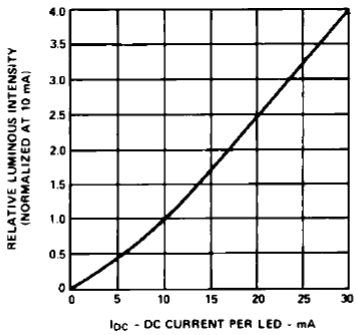



Figure 3. Relative luminous intensity vs. DC forward current.

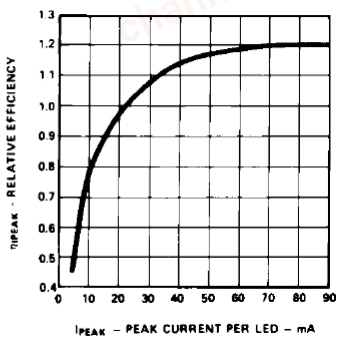



Figure 4. Relative efficiency (luminous intensity per unit current) vs. peak LED current.

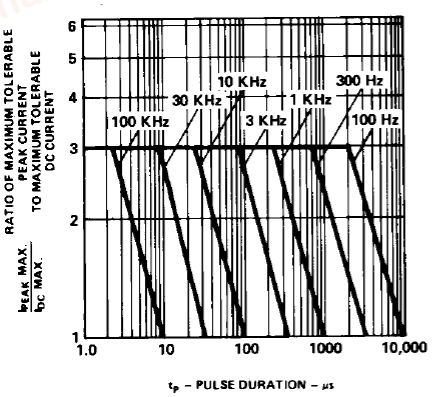



Figure 5. Maximum tolerable peak current vs. pulse duration ($I_{DC}$ MAX as per MAX ratings).

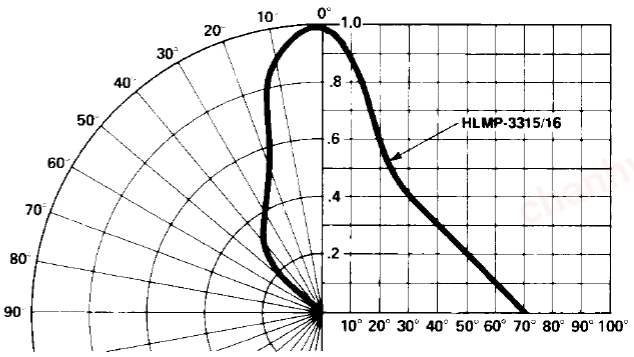



Figure 6. Relative luminous intensity vs. angular displacement.

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## Yellow HLMP-341X Series

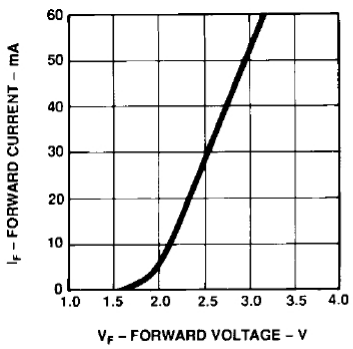



Figure 7. Forward current vs. forward voltage characteristics.

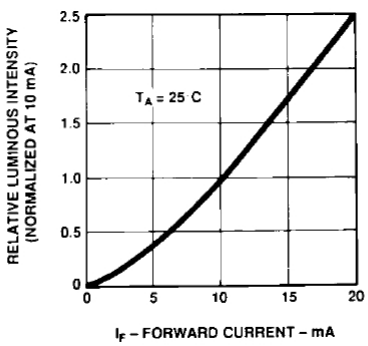



Figure 8. Relative luminous intensity vs. DC forward current.

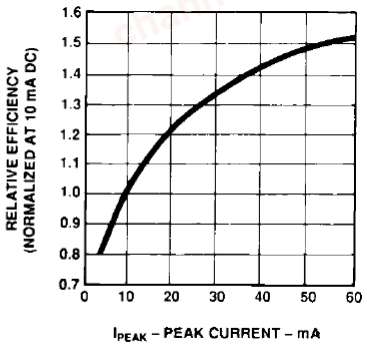



Figure 9. Relative efficiency (luminous intensity per unit current) vs. peak current.

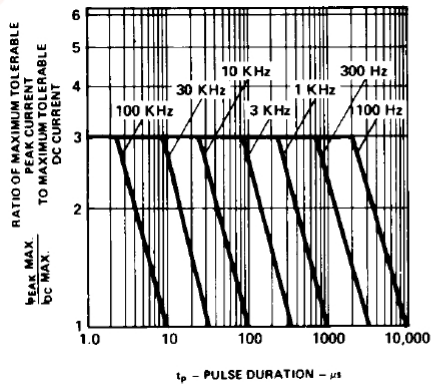



Figure 10. Maximum tolerable peak current vs. pulse duration ($I_{DC}$ MAX as per MAX ratings).

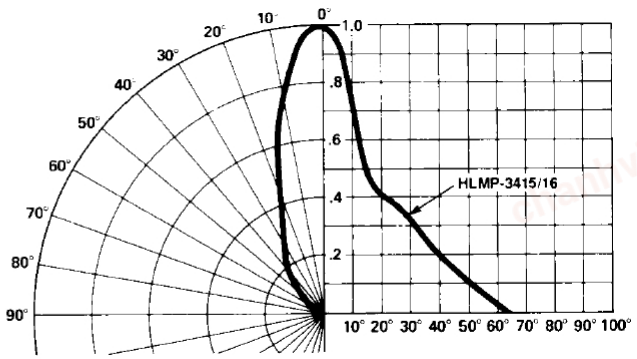



Figure 11. Relative luminous intensity vs. angular displacement.

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## Green HLMP-351X Series

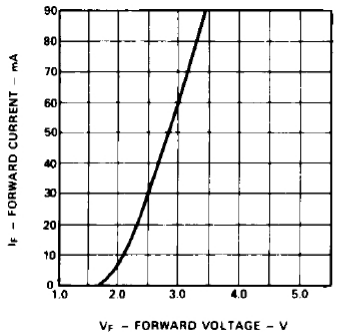



Figure 12. Forward current vs. forward voltage characteristics.

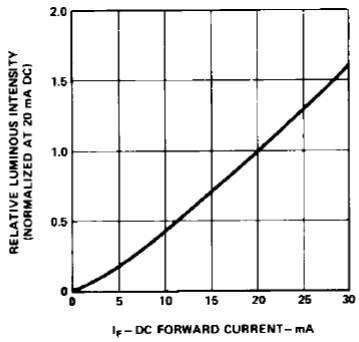



Figure 13. Relative luminous intensity vs. DC forward current.

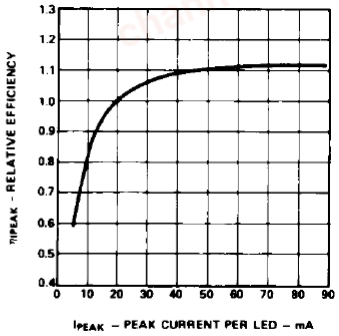



Figure 14. Relative efficiency (luminous intensity per unit current) vs. peak LED current.

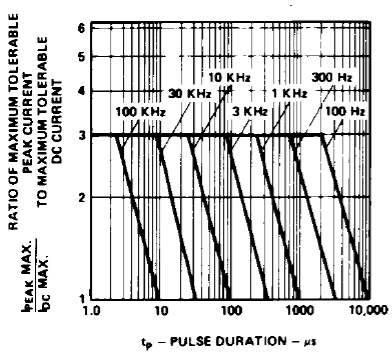



Figure 15. Maximum tolerable peak current vs. pulse duration ($I_{DC}$ MAX as per MAX ratings).

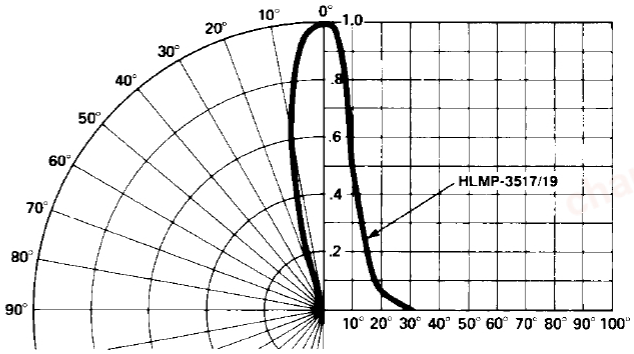



Figure 16. Relative luminous intensity vs. angular displacement. T-1$^3/_4$ lamp.

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**Table 2. Intensity Bin Limit**

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

**Table 2. (Cont'd)**

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

**Table 2. (Cont'd)**

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

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## Color Categories

| Color | Cat # | Lambda (nm) Min. | Max. |
|---|---|---|---|
| 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 |

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, minimum increment 1300 pcs/bag |
| 02 | Tape & Reel, straight leads, minimum increment 1300 pcs/bag |
| B1 | Right Angle Housing, uneven leads, minimum increment 500 pcs/bag |
| B2 | Right Angle Housing, even leads, minimum increment 500 pcs/bag |

**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.

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## 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 |
|---|---|---|---|
| Lead size (typ.) | 0.45 × 0.45 mm (0.018 × 0.018 in.) | 0.636 mm (0.025 in) | 0.98 to 1.08 mm (0.039 to 0.043 in) |
| Dambar shear-off area (max.) | 0.65 mm (0.026 in) | 0.919 mm (0.036 in) | |
| Lead size (typ.) | 0.50 × 0.50 mm (0.020 × 0.020 in.) | 0.707 mm (0.028 in) | 1.05 to 1.15 mm (0.041 to 0.045 in) |
| Dambar shear-off area (max.) | 0.70 mm (0.028 in) | 0.99 mm (0.039 in) | |

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

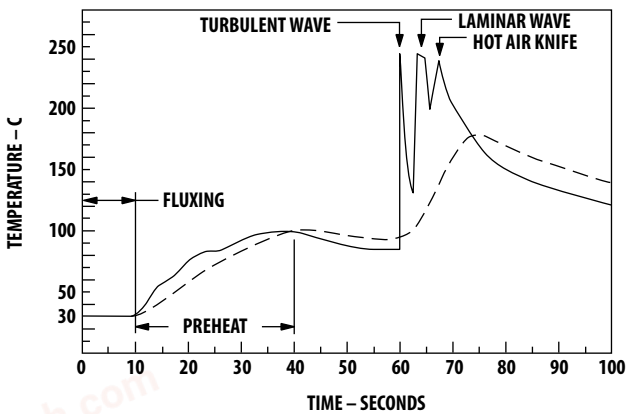



Figure 17. Recommended wave soldering profile.

BOTTOM SIDE OF PC BOARD
TOP SIDE OF PC BOARD

CONVEYOR SPEED = 1.83 M/MIN (6 FT/MIN)
PREHEAT SETTING = 150C (100C PCB)
SOLDER WAVE TEMPERATURE = 245C
AIR KNIFE AIR TEMPERATURE = 390C
AIR KNIFE DISTANCE = 1.91 mm (0.25 IN.)
AIR KNIFE ANGLE = 40
SOLDER: SN63; FLUX: RMA

NOTE: ALLOW FOR BOARDS TO BE SUFFICIENTLY COOLED BEFORE EXERTING MECHANICAL FORCE.

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AV02-1023EN - July 24, 2013