Data Sheet

# ASCB-WTF0-0A30A

## 2727 RGB Tricolor PLCC-6 Lens

## Overview

The Broadcom® ASCB-WTF0 series offers RGB tricolor LEDs in a compact form factor that is specifically designed for outdoor full-color signs. The LED is available in a 2.8 mm × 2.7 mm × 3.0 mm PLCC-6 package, featuring a single lens for closer-pitch signs. The diffused epoxy with a black outer appearance improves display contrast while maintaining high brightness.

To facilitate easy pick-and-place assembly, the LEDs are packed in tape and reel. Every reel is shipped in single intensity and color bin to ensure uniformity.

## Features

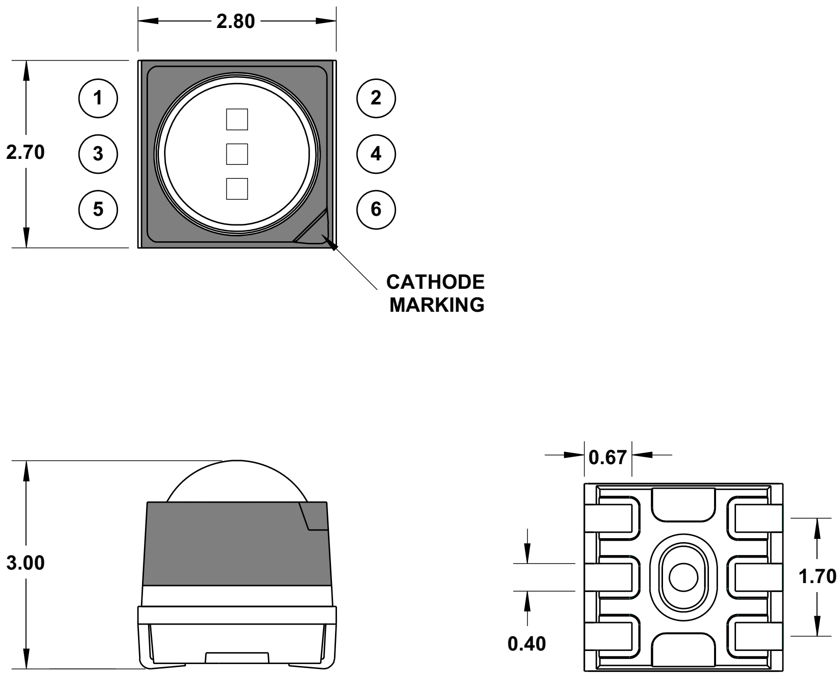
- Compact tricolor PLCC-6 LED with single lens
- Package with black outer appearance

## Applications

- Outdoor full-color signs
- Retail shop logo signs

**CAUTION!** This LED is ESD sensitive. Observe appropriate precautions during handling and processing. Refer to Application Note 1142 for additional details.

**Figure 1: Package Drawing**




| Pin | Configuration |
|---|---|
| 1 | Red Anode |
| 2 | Red Cathode |
| 3 | Green Anode |
| 4 | Green Cathode |
| 5 | Blue Anode |
| 6 | Blue Cathode |

**NOTE:**

1. All dimensions are in millimeters (mm).
2. Tolerance is ±0.20 mm unless otherwise specified.
3. Terminal finish = silver plating.

# Absolute Maximum Ratings

| Parameters | Red | Green | Blue | Unit |
|---|---|---|---|---|
| DC Forward Current[a] | 25 | 25 | 20 | mA |
| Peak Forward Current[b] | 100 | 100 | 100 | mA |
| Power Dissipation | 60 | 80 | 64 | mW |
| Reverse Voltage | Not recommended for reverse bias operation | | | |
| LED Junction Temperature | 105 | | | °C |
| Operating Temperature Range | –40 to +85 | | | °C |
| Storage Temperature Range | –40 to +100 | | | °C |

a. Derate linearly as shown in Figure 11 and Figure 12.

b. Duty factor = 10%, frequency = 1 kHz.

# Optical Characteristics ($T_J$ = 25°C)

| Color | Luminous Intensity, $I_V$ (mcd)[a] | | | Dominant Wavelength, $\lambda_d$ (nm)[b] | | | Peak Wavelength, λp (nm) | Viewing Angle, $2\theta_{½}$ (°)[c] | Test Current (mA) |
|---|---|---|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. | Typ. | Typ. | |
| Red | 650 | 950 | 1430 | 617 | 620 | 628 | 626 | 75 | 15 |
| Green | 1150 | 1500 | 2535 | 523 | 527 | 533 | 519 | 75 | 8 |
| Blue | 120 | 150 | 265 | 465 | 470 | 476 | 465 | 75 | 5 |

a. The luminous intensity, $I_V$, is measured at the mechanical axis of the package, and it is tested with a single-current pulse condition. The actual peak of the spatial radiation pattern might not be aligned with the axis.

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

c. $\theta_{½}$ is the off-axis angle where the luminous intensity if half of the peak intensity.

# Electrical Characteristics ($T_J$ = 25°C)

| Color | Forward Voltage, $V_F$ (V)[a] | | | Reverse Voltage, $V_R$ (V) at $I_R$ = 10 mA[b] | Thermal Resistance, $R_{\theta J\text{-}S}$ (°C/W) – Three Chips ON[c] |
|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. |
| Red | 1.7 | 2.1 | 2.4 | 4.0 | 520 |
| Green | 2.4 | 2.6 | 3.2 | 4.0 | 520 |
| Blue | 2.4 | 2.7 | 3.2 | 4.0 | 730 |

a. The forward voltage tolerance is ±0.1V. $V_F$ is tested at a test current similar to the optical characteristics test current.

b. Indicates the product final test condition. Long-term reverse bias is not recommended.

c. Thermal resistance from the LED junction to the solder point.

# Part Numbering System

A S C B – W T $x_1$ 0 – 0 $x_2$ $x_3$ $x_4$ $x_5$

<table>
<tr><th>Code</th><th>Description</th><th colspan="3">Option</th></tr>
<tr><td>$x_1$</td><td>Package Type</td><td>F</td><td colspan="2">Black outer appearance</td></tr>
<tr><td rowspan="3">$x_2$</td><td rowspan="3">Minimum Intensity Bin</td><td rowspan="3">A</td><td>Red: Bin R1</td><td rowspan="4">Red: Bin R1, R2, R3<br>Green: Bin G1, G2, G3<br>Blue: Bin B1, B2, B3</td></tr>
<tr><td>Green: Bin G1</td></tr>
<tr><td>Blue: Bin B1</td></tr>
<tr><td>$x_3$</td><td>Number of Intensity Bins</td><td>3</td><td>3 intensity bins from minimum</td></tr>
<tr><td rowspan="3">$x_4$</td><td rowspan="3">Color Bin Option</td><td rowspan="3">0</td><td colspan="2">Red: Full distribution</td></tr>
<tr><td colspan="2">Green: Bin A, B, C, D, E, F, G, H</td></tr>
<tr><td colspan="2">Blue: Bin J, K, L, M, N, P, Q, R, S</td></tr>
<tr><td>$x_5$</td><td>Test Option</td><td>A</td><td colspan="2">Test current: Red = 15 mA, Green = 8 mA, Blue = 5 mA</td></tr>
</table>

# Bin Information

## Intensity Bin Limits (CAT)

| Bin ID | Luminous Intensity, $I_V$ (mcd) | |
|---|---|---|
| | Min. | Max. |
| **Red** | | |
| R1 | 650 | 850 |
| R2 | 850 | 1100 |
| R3 | 1100 | 1430 |
| **Green** | | |
| G1 | 1150 | 1500 |
| G2 | 1500 | 1950 |
| G3 | 1950 | 2535 |
| **Blue** | | |
| B1 | 120 | 155 |
| B2 | 155 | 205 |
| B3 | 205 | 265 |

Tolerance = ±12%

Example of bin information on reel and packaging label:

| | | |
|---|---|---|
| CAT : R2 G2 B2 | – | Red intensity bin R2 |
| | – | Green intensity bin G2 |
| | – | Blue intensity bin B2 |
| BIN : BL | – | Green color bin B |
| | – | Blue color bin L |

## Color Bin Limits (BIN)

| Bin ID | Dominant Wavelength, $\lambda_d$ (nm) | |
|---|---|---|
| | Min. | Max. |
| **Red** | | |
| — | 617 | 628 |
| **Green** | | |
| A | 523 | 526 |
| B | 524 | 527 |
| C | 525 | 528 |
| D | 526 | 529 |
| E | 527 | 530 |
| F | 528 | 531 |
| G | 529 | 532 |
| H | 530 | 533 |
| **Blue** | | |
| J | 465 | 468 |
| K | 466 | 469 |
| L | 467 | 470 |
| M | 468 | 471 |
| N | 469 | 472 |
| P | 470 | 473 |
| Q | 471 | 474 |
| R | 472 | 475 |
| S | 473 | 476 |

Tolerance = ±1.0 nm

**Figure 2: Spectral Power Distribution**

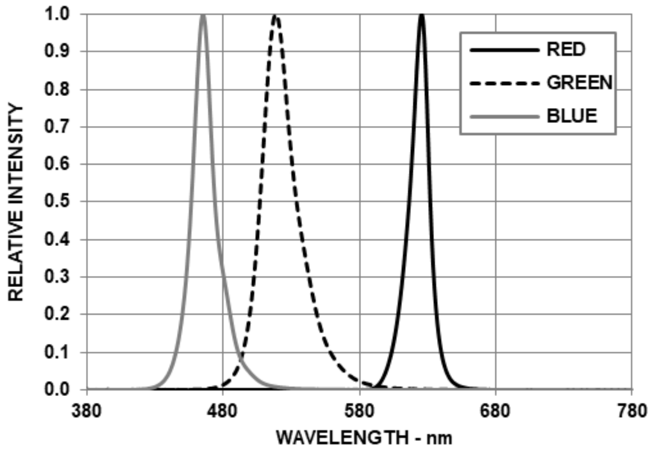



**Figure 3: Forward Current vs. Forward Voltage**

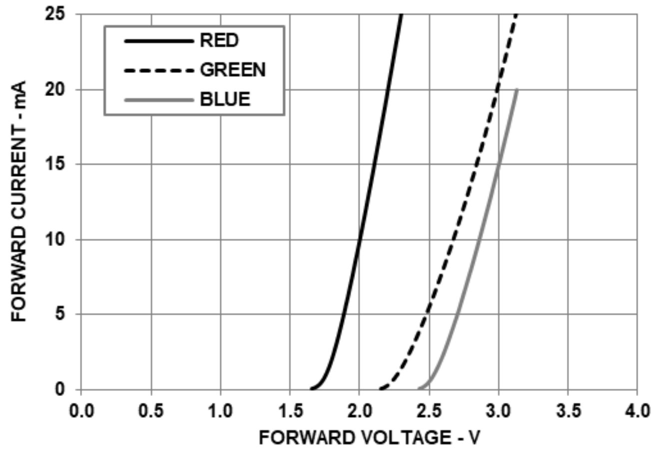



**Figure 4: Relative Luminous Intensity vs. Mono Pulse Current**

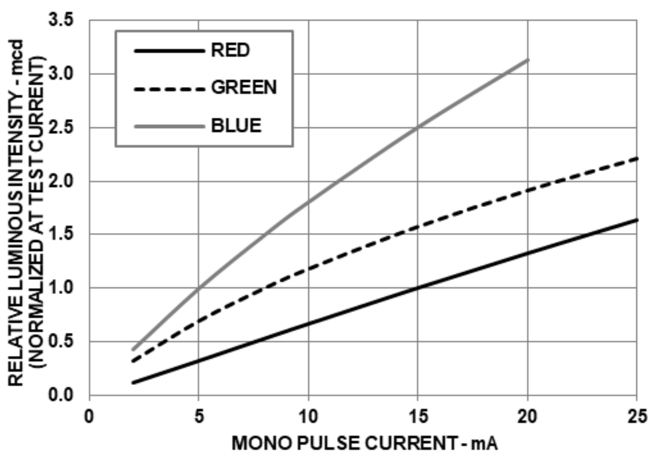



**Figure 5: Dominant Wavelength Shift vs. Mono Pulse Current**

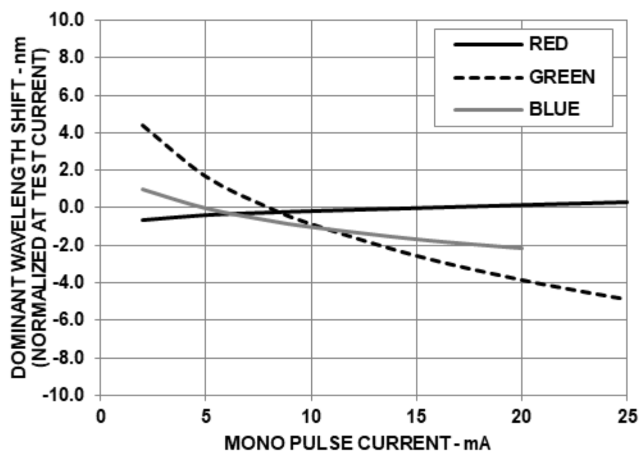



**Figure 6: Radiation Pattern for X-Axis**

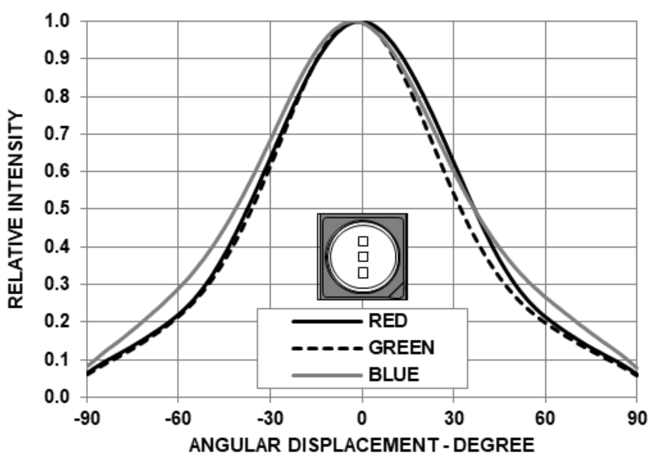



**Figure 7: Radiation Pattern for Y-Axis**

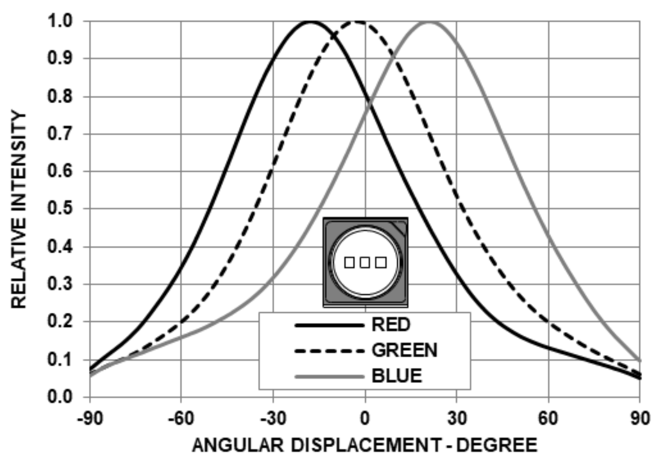


**Figure 8: Relative Light Output vs. Junction Temperature**

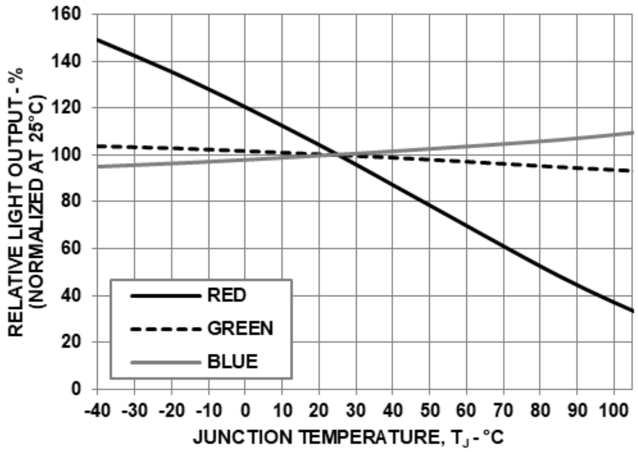



**Figure 9: Forward Voltage Shift vs. Junction Temperature**

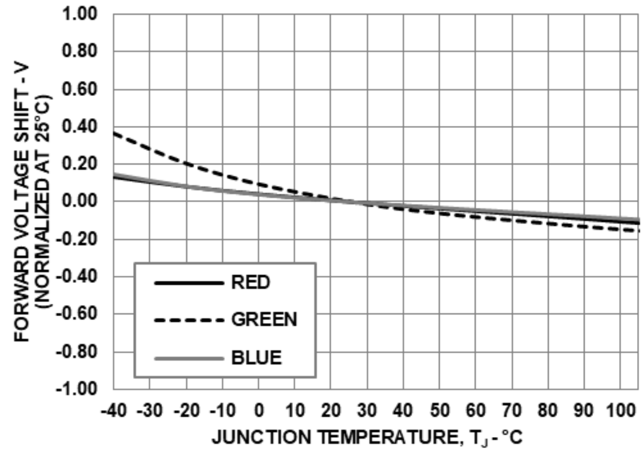



**Figure 10: Maximum Forward Current vs. Ambient Temperature for Red, Green, and Blue: Three Chips ON**

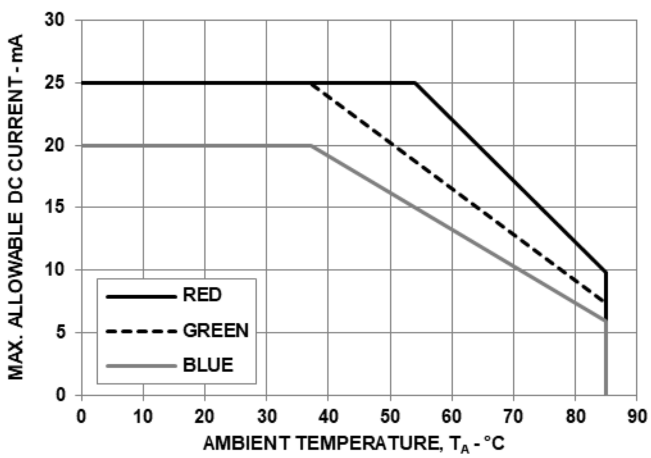



**Figure 11: Maximum Forward Current vs. Solder Temperature for Red, Green, and Blue: Three Chips ON**

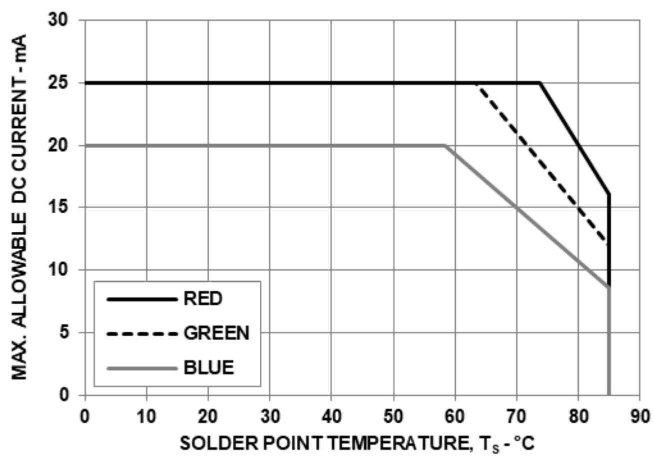
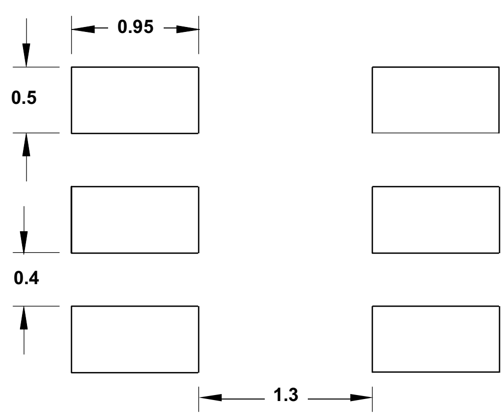
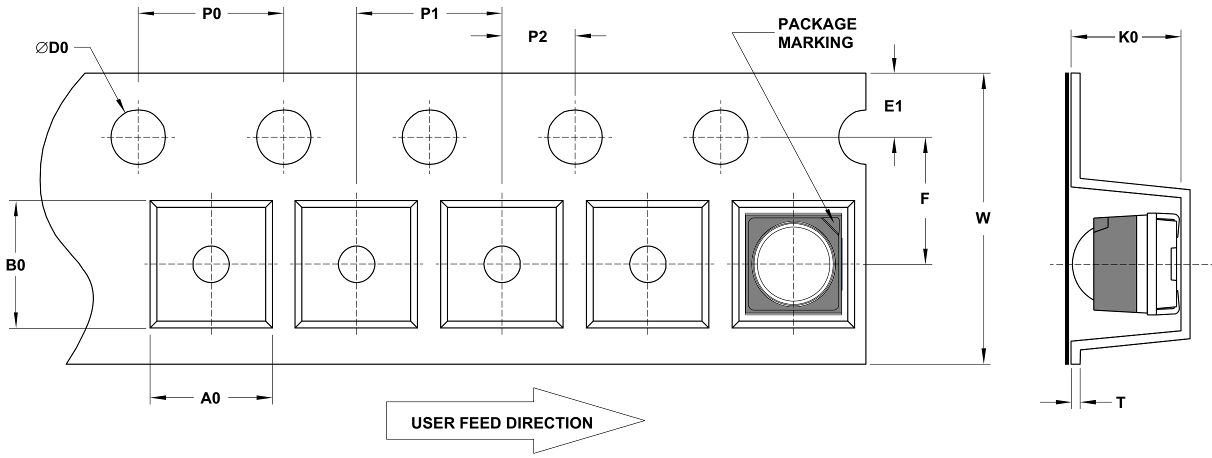



**Figure 12: Recommended Soldering Pad Pattern**




**NOTE:** All dimensions are in millimeters (mm).

**Figure 13: Carrier Tape Drawing**



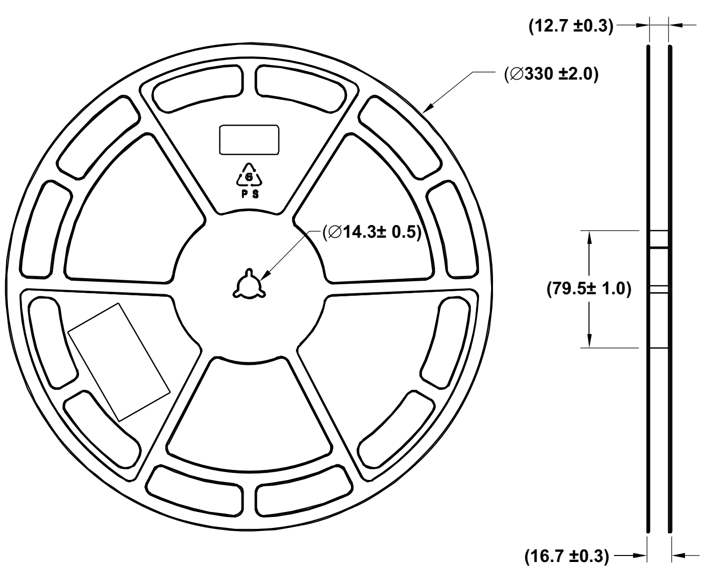

| F | E1 | P0 | P1 | P2 | D0 | W |
|---|---|---|---|---|---|---|
| 3.5 ± 0.1 | 1.75 ± 0.1 | 4.0 ± 0.1 | 4.0 ± 0.1 | 2.0 ± 0.1 | 1.6 ± 0.1 | 8.1 ± 0.1 |

| A0 | B0 | K0 | T |
|---|---|---|---|
| 2.9 ± 0.2 | 3.05 ± 0.2 | 3.3 ± 0.2 | 0.4 ± 0.05 |

**NOTE:**

1. All dimensions are in millimeters (mm).
2. Quantity per reel is 5000 pieces.

**Figure 14: Reel Drawing**




**NOTE:**

1. All dimensions are in millimeters (mm).
2. Dimensions in parentheses are for reference only.

# Precautionary Notes

## Soldering

- Do not perform reflow soldering more than twice. Observe necessary precautions of handling moisture-sensitive devices as stated in the following section.
- Do not apply any pressure or force on the LED during reflow and after reflow when the LED is still hot.
- Use reflow soldering to solder the LED. Use hand soldering only for rework if unavoidable, but it must be strictly controlled to the following conditions:
  - Soldering iron tip temperature = 315°C maximum
  - Soldering duration = 3 seconds maximum
  - Number of cycles = 1 only
  - Power of soldering iron = 50W maximum
- Do not touch the LED package body with the soldering iron except for the soldering terminals, because it can cause damage to the LED.
- Confirm beforehand whether the functionality and performance of the LED are affected by soldering with hand soldering.

**Figure 15: Recommended Lead-Free Reflow Soldering Profile**

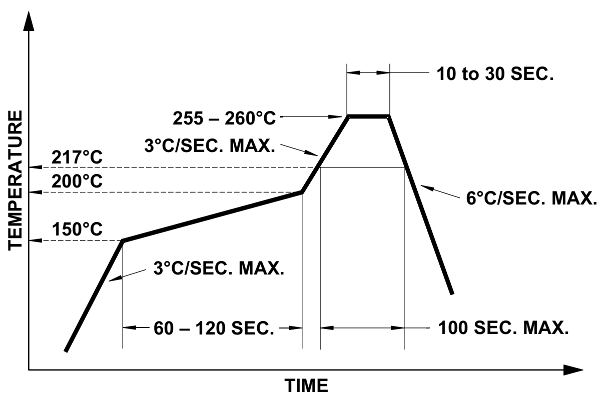
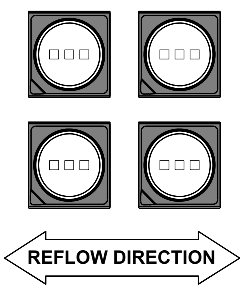



**Figure 16: Recommended Board Reflow Direction**




## Handling Precautions

Observe special handling precautions during assembly of epoxy encapsulated LED products. Failure to comply might lead to damage and premature failure of the LED.

- Do not stack assembled PCBs together. Use an appropriate rack to hold the PCBs.
- For automated pick-and-place, Broadcom has tested a nozzle size with an OD of 3.5 mm and an ID of 1.7 mm to work with this LED. However, due to the possibility of variations in other parameters, such as pick-and-place machine maker/model and other settings of the machine, verify that the selected nozzle will not cause damage to the LED.

## Handling Moisture-Sensitive Devices

This product has a Moisture Sensitive Level 5a rating per JEDEC J-STD-020. For additional details and a review of proper handling procedures, refer to Broadcom Application Note 5305, *Handling Moisture-Sensitive Surface-Mount LEDs.*

- Before use:
  - An unopened moisture barrier bag (MBB) can be stored at <40°C/90% RH for 12 months. If the actual shelf life has exceeded 12 months and the humidity indicator card (HIC) indicates that baking is not required, then it is safe to reflow the LEDs per the original MSL rating.
  - Do not open the MBB prior to assembly (for example, for IQC). If unavoidable, the MBB must be properly resealed with fresh desiccant and HIC. The exposed duration must be taken in as floor life.
- Control after opening the MBB:
  - Read the HIC immediately upon opening the MBB.
  - Keep the LEDs at <30°C/60% RH at all times, and complete all high-temperature-related processes, including soldering, curing, or rework, within 24 hours.
- Control for unfinished reels:

  Store unused LEDs in a sealed MBB with desiccant or a desiccator at <5% RH.
- Control of assembled boards:

  If the PCB soldered with the LEDs is to be subjected to other high-temperature processes, store the PCB in a sealed MBB with desiccant or desiccator at <5% RH to ensure that all LEDs have not exceeded their floor life of 24 hours.
- Baking is required if any of these conditions exist:
  - The HIC indicates a change in color for 10% and 5%, as stated on the HIC.
  - The LEDs are exposed to conditions of >30°C/60% RH at any time.
  - The LED’s floor life exceeded 24 hours.

  The recommended baking condition is 65°C ± 5°C for 24 hours.

  Baking can be done only once.
- Storage:

  The soldering terminals of these Broadcom LEDs are silver plated. If the LEDs are exposed in an ambient environment for too long, the silver plating might become oxidized, thus affecting its solderability performance. As such, keep unused LEDs in a sealed MBB with desiccant or in a desiccator at <5% RH.

## Application Precautions

- The drive current of the LED must not exceed the maximum allowable limit across temperature as stated in this data sheet. Constant current driving is recommended to ensure consistent performance.
- The circuit design must cater to the whole range of forward voltage ($V_F$) of the LEDs to ensure that the intended drive current can always be achieved.
- The LED exhibits slightly different characteristics at different drive currents, which can result in a larger variation in performance (meaning intensity, wavelength, and forward voltage). Set the application current as close as possible to the test current to minimize these variations.
- The LED is not intended for reverse bias. Use other appropriate components for such purposes. When driving the LED in matrix form, ensure that the reverse bias voltage does not exceed the allowable limit of the LED.
- Because actual application might not be exactly similar to the test conditions, do verify that the LED will not be damaged by prolonged exposure in the intended environment.
- Avoid rapid changes in ambient temperature, especially in high-humidity environments, because they cause condensation on the LED.
- If the LED is intended to be used in harsh or outdoor environments, protect the LED against damages caused by rainwater, dust, oil, corrosive gases, external mechanical stresses, and so on.

## Thermal Management

The optical, electrical, and reliability characteristics of the LED are affected by temperature. Keep the junction temperature ($T_J$) of the LED below the allowable limit at all times. $T_J$ can be calculated as follows:

$$T_J = T_A + R_{\theta J\text{-}A} \times I_F \times V_{Fmax}$$

Where:

$T_A$ = Ambient temperature (°C)

$R_{\theta J\text{-}A}$ = Thermal resistance from LED junction to ambient (°C/W)

$I_F$ = Forward current (A)

$V_{Fmax}$ = Maximum forward voltage (V)

The complication of using this formula lies in $T_A$ and $R_{\theta J\text{-}A}$. Actual $T_A$ is sometimes subjective and hard to determine. And $R_{\theta J\text{-}A}$ varies from system to system depending on design and is usually not known.

Another way of calculating $T_J$ is by using the solder point temperature ($T_S$) as follows:

$$T_J = T_S + R_{\theta J\text{-}S} \times I_F \times V_{Fmax}$$

Where:

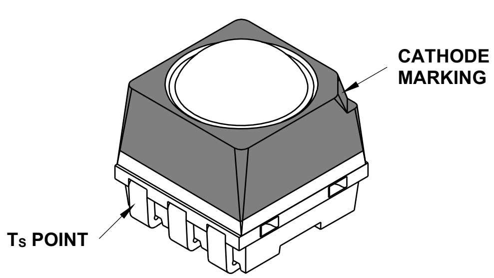
$T_S$ = LED solder point temperature as shown in the following figure (°C)

$R_{\theta J\text{-}S}$ = Thermal resistance from junction to solder point (°C/W)

$I_F$ = Forward current (A)

$V_{Fmax}$ = Maximum forward voltage (V)

**Figure 17: Solder Point Temperature on PCB**




$T_S$ can be easily measured by mounting a thermocouple on the soldering joint as shown in preceding figure, while $R_{\theta J\text{-}S}$ is provided in this data sheet. Verify the $T_S$ of the LED in the final product to ensure that the LEDs are operating within all maximum ratings stated in this data sheet.

## Eye Safety Precautions

LEDs can pose optical hazards when in operation. Do not look directly at operating LEDs because it might be harmful to the eyes. For safety reasons, use appropriate shielding or personal protective equipment.

Lead (Pb) Free
RoHS Compliant