

Amber PLCC-2 Surface Mount LED with Black Surface

Data Sheet

Description

This family of Surface Mount LEDs is packaged in the industry-standard PLCC-2 package and has high reliability performance designed to work under a wide range of environmental conditions. This high reliability feature makes it ideally suited to be used in various signage applications. This surface mount (SMT) LED comes with a black top surface to minimize reflection from ambient light and improve contrast.

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

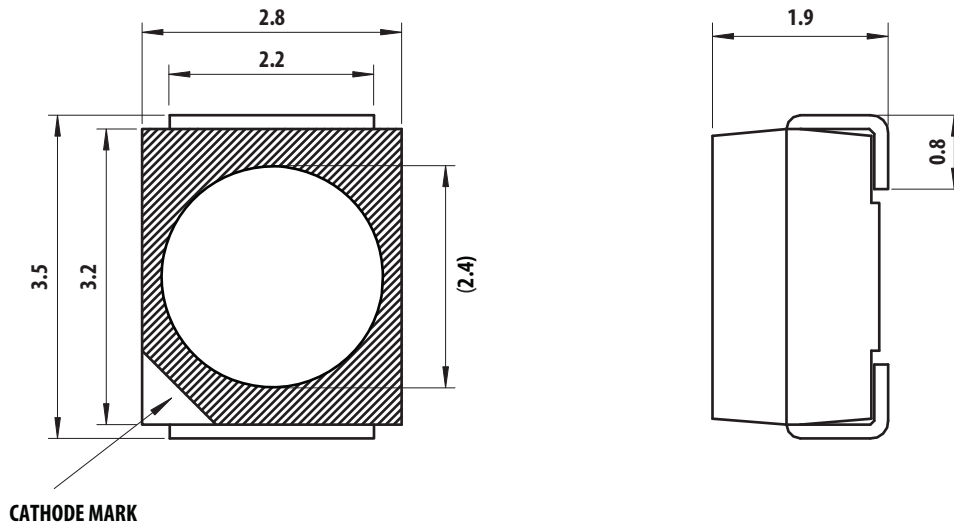
Features

- Industry-standard PLCC-2 package.
- High reliability LED package with enhanced silicone resin encapsulation.
- High brightness using AlInGaP dice technology.
- Available in Amber color only.
- Black surface for enhanced contrast.
- Wide angle viewing angle at 120°.
- JEDEC MSL 3.

Applications

- Variable message signs.
- Passenger information signs.
- Bus information signs.

CAUTION	This LED is ESD sensitive. Observe appropriate precautions during handling and processing. Refer to application note AN-1142 for additional details.
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Figure 1 Package Drawing**NOTE**

1. Dimensions in bracket are for reference only.
2. Tolerance is ± 0.20 mm unless otherwise specified.
3. Encapsulation = silicone.
4. Terminal finish = silver plating.
5. All dimensions in millimeters (mm).

Performance**Absolute Maximum Ratings**

Parameter	ASMM-CA04-Nxxx2	Unit
DC Forward Current ^a	30	mA
Peak Forward Current ^b	100	mA
Power Dissipation	78	mW
LED Junction Temperature	110	°C
Operating Temperature Range	-40 to +100	°C
Storage Temperature Range	-40 to +100	°C

a. Derate linearly as shown in Figure 10 and Figure 11.

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

Optical Characteristics ($T_J = 25^\circ\text{C}$, $I_F = 20\text{ mA}$)

Part Number	Color	Luminous Intensity, I_V (mcd) ^{a,b}			Peak Wavelength, λ_p (nm)	Dominant Wavelength, λ_d (nm) ^c	Viewing Angle, $2\theta_{1/2}$ (°) ^d	Dice Technology
		Min.	Typ.	Max.	Typ.	Typ.	Typ.	
ASMM-CA04-CV2C2	Amber	715.0	—	1125.0	592	590	120	AlInGaP
ASMM-CA04-CV6J2	Amber	900.0	—	1400.0	592	590	120	AlInGaP

- a. The luminous intensity, I_V is measured at the mechanical axis of the LED package at a single current pulse condition. The actual peak of the spatial radiation pattern may not be aligned with the axis.
- b. Luminous intensity tolerance: $\pm 12\%$.
- c. The dominant wavelength, λ_d , is derived from the CIE Chromaticity Diagram and represents the color of the device.
- d. $\theta_{1/2}$ is the off-axis angle where the luminous intensity is $1/2$ the peak intensity.

Electrical Characteristics ($T_J = 25^\circ\text{C}$, $I_F = 20\text{ mA}$)

Part Number	Color	Forward Voltage, V_F (V) ^a			Reverse Voltage, V_R (V) at $I_R = 100\text{ }\mu\text{A}$ ^b	Thermal Resistance, $R\theta_{J-S}$ (°C/W) ^c	Dice Technology
		Min.	Typ.	Max.	Min.	Typ.	
ASMM-CA04-CV2C2	Amber	1.7	—	2.6	5	138	AlInGaP
ASMM-CA04-CV6J2	Amber	1.7	—	2.6	5	138	AlInGaP

- a. Forward voltage, V_F tolerance: $\pm 0.1\text{V}$.
- b. Indicates product final test condition only. Long-term reverse bias is not recommended.
- c. Thermal resistance from LED junction to solder point.

Part Numbering System

A S M M - C x1 0 4 - C x2 x3 x4 x5

Code	Description	Option	
x ₁	Color	A	Amber
x ₂	Minimum Intensity Bin	V	Intensity Bin V
x ₃	Number of Half Bins	2	2 Half Bins starting from (x ₂)1
		6	2 Half Bins starting from (x ₂)2
x ₄	Color Bin Option	C	3 and 4 only
		J	3, 4, and 5 only
x ₅	Test Option	2	Test Current = 20 mA

Part Number Example

ASMM-CA04-CV2C2

x₁ : A — Amber color
 x₂, x₃ : V, 2 — 2 half bins from intensity bin V1 (V1, V2)
 x₄ : C — Color bin 3 and 4 only
 x₅ : 2 — Test current = 20 mA

Bin Information

Intensity Bin Limits (CAT)

Bin ID	Luminous Intensity (mcd)	
	Min.	Max.
V1	715.0	900.0
V2	900.0	1125.0
W1	1125.0	1400.0

Tolerance = ±12%.

Color Bin Limits (BIN)

Bin ID	Dominant Wavelength, λ_d	
	Min.	Max.
3	586.0	589.0
4	589.0	592.0
5	592.0	595.0

Tolerance = ±1.0 nm.

Example of bin information on reel and packaging label:

CAT : V2 — Intensity bin V2
 BIN : 3 — Color bin 3

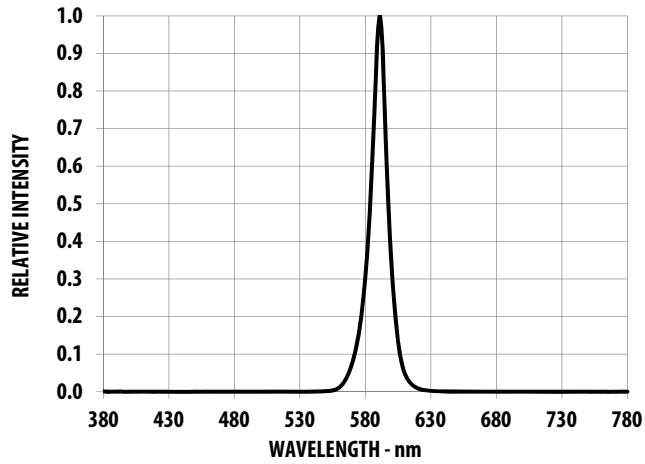
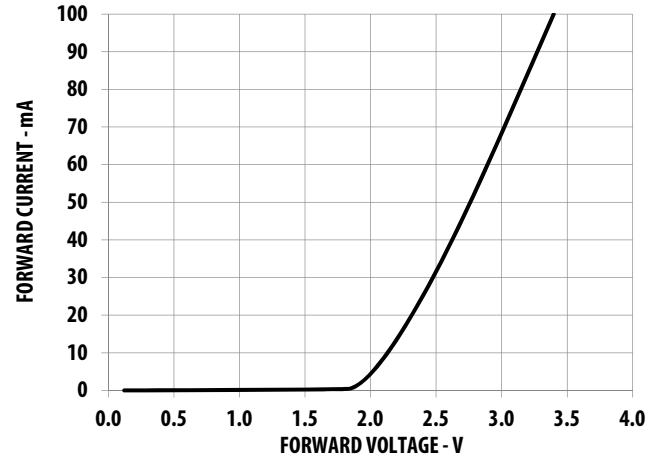
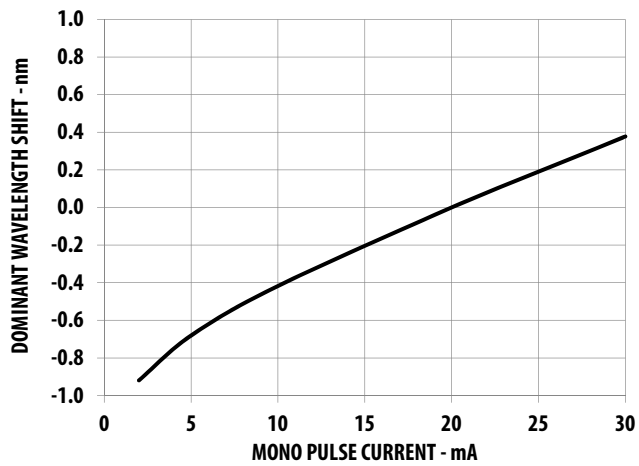
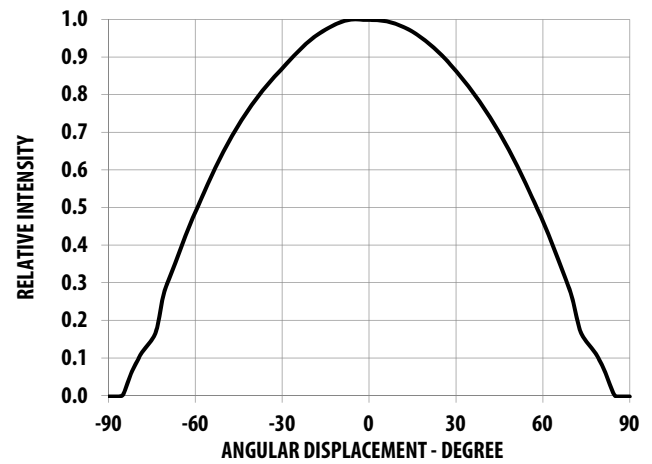
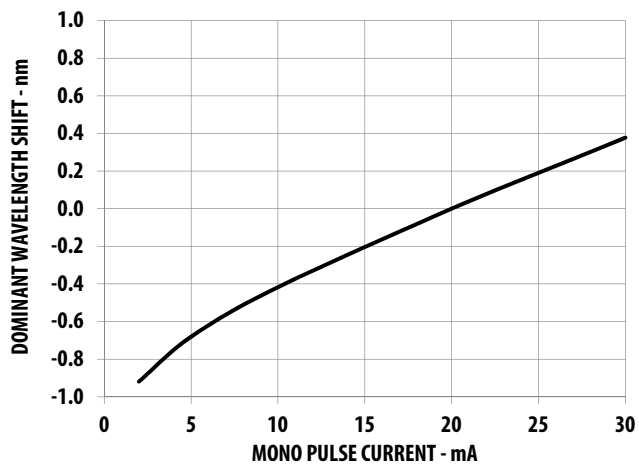
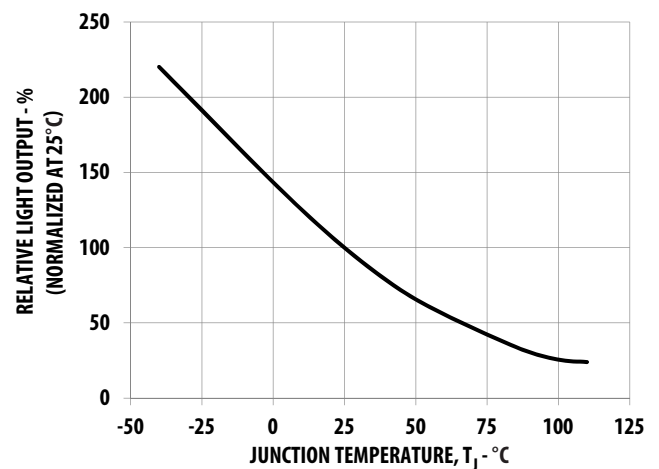
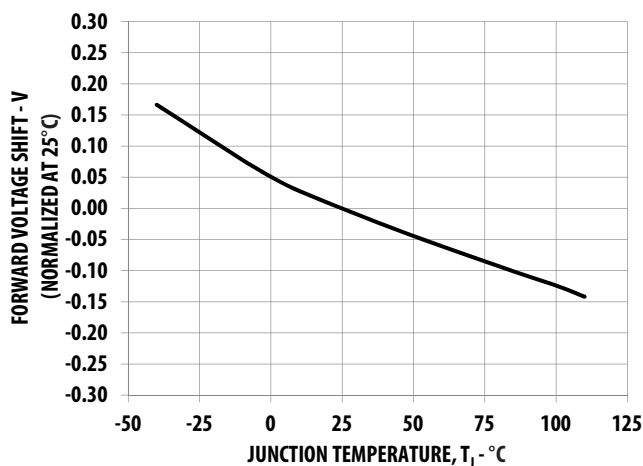
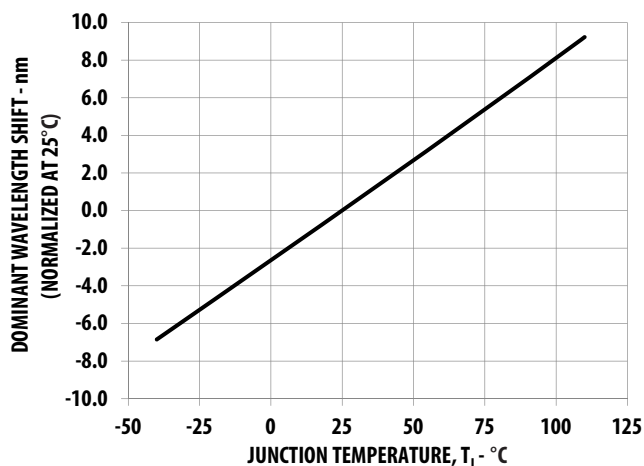
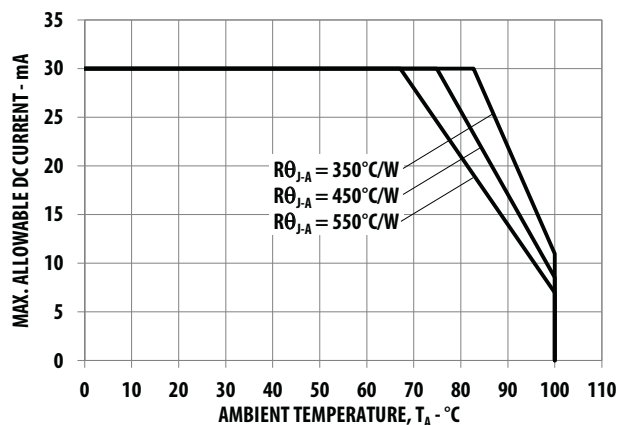
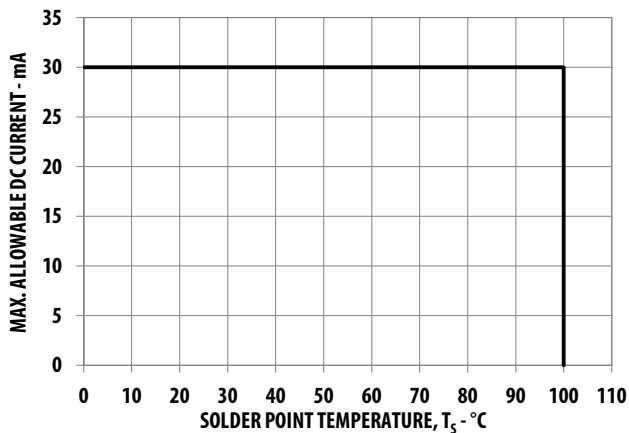
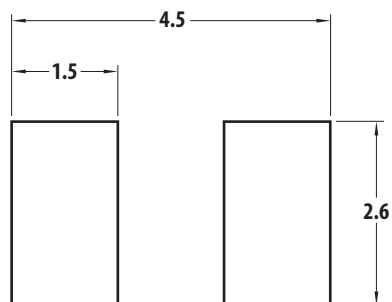
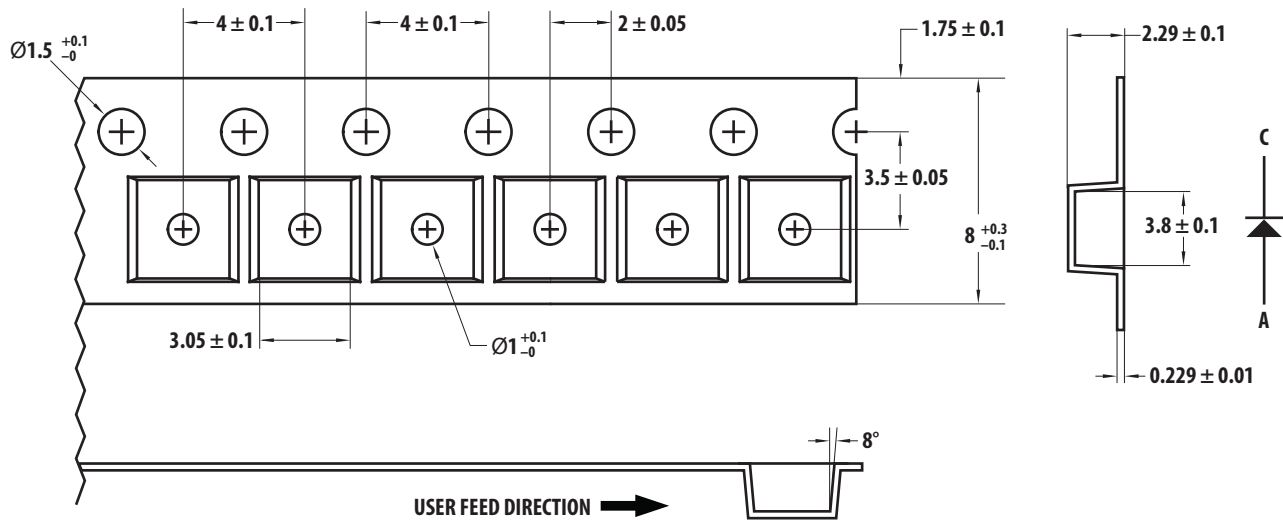
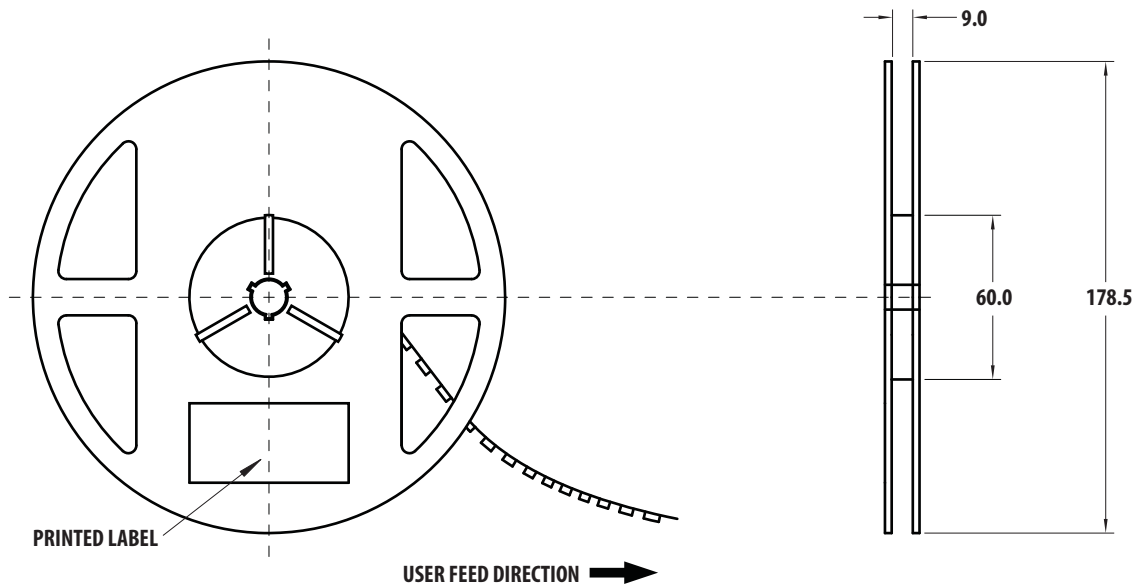
Figure 2 Spectral Power Distribution**Figure 3 Forward Current vs. Forward Voltage****Figure 4 Relative Luminous Intensity vs. Mono Pulse Current****Figure 5 Radiation Pattern****Figure 6 Dominant Wavelength Shift vs. Mono Pulse Current****Figure 7 Relative Light Output vs. Junction Temperature**

Figure 8 Forward Voltage Shift vs. Junction Temperature**Figure 9 Dominant Wavelength Shift vs. Junction Temperature****Figure 10 Maximum Forward Current vs. Ambient Temperature (Derated based on $T_{JMAX} = 110^\circ\text{C}$, $R\theta_{JA} = 350^\circ\text{C/W}$, 450°C/W and 550°C/W)****Figure 11 Maximum Forward Current vs. Solder Point Temperature (Derated based on $T_{JMAX} = 110^\circ\text{C}$, $R\theta_{JS} = 138^\circ\text{C/W}$)****Figure 12 Recommended Soldering Pad Pattern**

Note: All dimensions are in millimeters.

Figure 13 Carrier Tape Dimensions

Note: All dimensions are in millimeters.

Figure 14 Reel Dimensions

Note: All dimensions are in millimeters.

Precautionary Notes

Soldering

- Do not perform reflow soldering more than twice. Observe necessary precautions of handling moisture-sensitive device 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 following conditions:
 - Soldering iron tip temperature = 315°C max.
 - Soldering duration = 3 sec max.
 - Number of cycles = 1 only.
 - Power of soldering iron = 50W max.
- Do not touch the LED package body with the soldering iron except for the soldering terminals, as it may cause damage to the LED.
- Confirm beforehand whether the functionality and performance of the LED is affected by soldering with hand soldering.

Figure 15 Recommended Lead-Free Reflow Soldering Profile

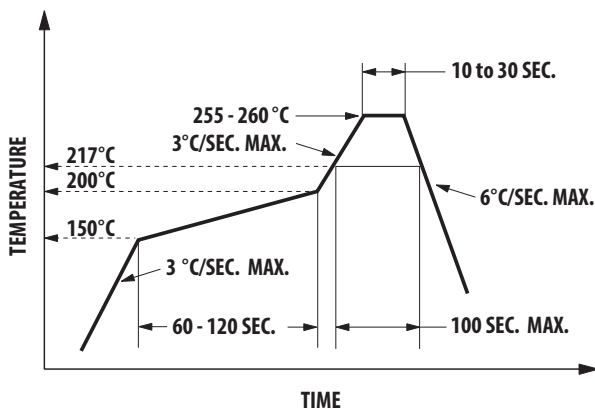
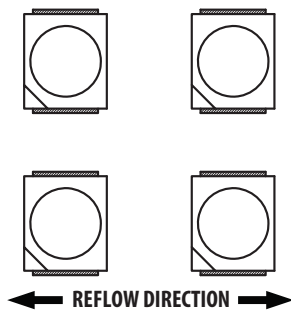


Figure 16 Recommended Board Reflow Direction



Handling Precautions

The encapsulation material of the LED is made of silicone for better product reliability. Compared to epoxy encapsulant, which is hard and brittle, silicone is softer and flexible. Observe special handling precautions during assembly of silicone encapsulated LED products. Failure to comply might lead to damage and premature failure of the LED. Refer to Broadcom Application Note AN5288, *Silicone Encapsulation for LED: Advantages and Handling Precautions*, for additional information.

- Do not poke sharp objects into the silicone encapsulant. Sharp objects, such as tweezers or syringes, might apply excessive force or even pierce through the silicone and induce failures to the LED die or wire bond.
- Do not touch the silicone encapsulant. Uncontrolled force acting on the silicone encapsulant might result in excessive stress on the wire bond. Hold the LED only by the body.
- Do not stack assembled PCBs together. Use an appropriate rack to hold the PCBs.
- Surface of silicone material attracts dust and dirt easier than epoxy due to its surface tackiness. To remove foreign particles on the surface of silicone, use a cotton bud with isopropyl alcohol (IPA). During cleaning, rub the surface gently without putting too much pressure on the silicone. Ultrasonic cleaning is not recommended.
- For automated pick and place, Broadcom has tested a nozzle size with OD 1.5 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 of Moisture-Sensitive Device

This product has a Moisture Sensitive Level 3 rating per JEDEC J-STD-020. Refer to Broadcom Application Note AN5305, *Handling of Moisture Sensitive Surface Mount Devices*, for additional details and a review of proper handling procedures.

- 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, 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 of MBB.
 - Keep the LEDs at <30°/60%RH at all times, and complete all high temperature-related processes, including soldering, curing or rework within 168 hours.
- Control for unfinished reel:

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 168 hours.
- Baking is required if:
 - The HIC indicator 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 168 hours.

The recommended baking condition is: 60 ± 5°C for 20 hours.

Baking can only be done once.
- Storage:

The soldering terminals of these Broadcom LEDs are silver plated. If the LEDs are exposed in ambient environment for too long, the silver plating might be 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 the data sheet. Constant current driving is recommended to ensure consistent performance.
- Circuit design must cater to the whole range of forward voltage (V_F) of the LEDs to ensure 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 of 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.
- Do not use the LED in the vicinity of material with sulfur content or in environments of high gaseous sulfur compounds and corrosive elements. Examples of material that might contain sulfur are rubber gaskets, room-temperature vulcanizing (RTV) silicone rubber, rubber gloves, and so on. Prolonged exposure to such environments can affect the optical characteristics and product life.
- Because actual application might not be exactly similar to the test conditions, verify that the LED will not be damaged by prolonged exposure in the intended environment.
- Avoid rapid change 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 environment, protect the LED against damages caused by rain water, water, dust, oil, corrosive gases, external mechanical stresses, and so on.

Thermal Management

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:

$$T_J = T_A + R\theta_{J-A} \times I_F \times V_{Fmax}$$

where:

T_A = ambient temperature (°C).

$R\theta_{J-A}$ = 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 $R\theta_{J-A}$. Actual T_A is sometimes subjective and hard to determine. $R\theta_{J-A}$ 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:

$$T_J = T_S + R\theta_{J-S} \times I_F \times V_{Fmax}$$

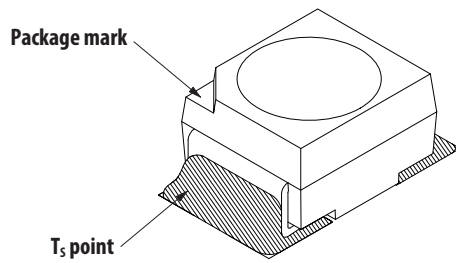
where:

T_S = LED solder point temperature as shown in [Figure 17](#) (°C).

$R\theta_{J-S}$ = 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 [Figure 17](#), while $R\theta_{J-S}$ 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 may 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.

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