Data Sheet

CSMM-CWG3-NX7x2

Low Power 3528 PLCC2 Surface Mount LED

Overview

The Broadcom® CSMM-CWG3 surface mount LEDs use InGaN chip technology with superior package design to enable them to produce better light output performance. They are able to dissipate heat more efficiently resulting in better performance with higher reliability.

These LEDs operate under a wide range of environmental conditions making ideal for various applications.

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 provide close uniformity.

Features

- High reliability package with enhanced silicone resin encapsulation.
- Available in CCT 4500K-10000K.
- Product qualification tests are based on AEC-Q101 guidelines.
- JEDEC MSL 3.

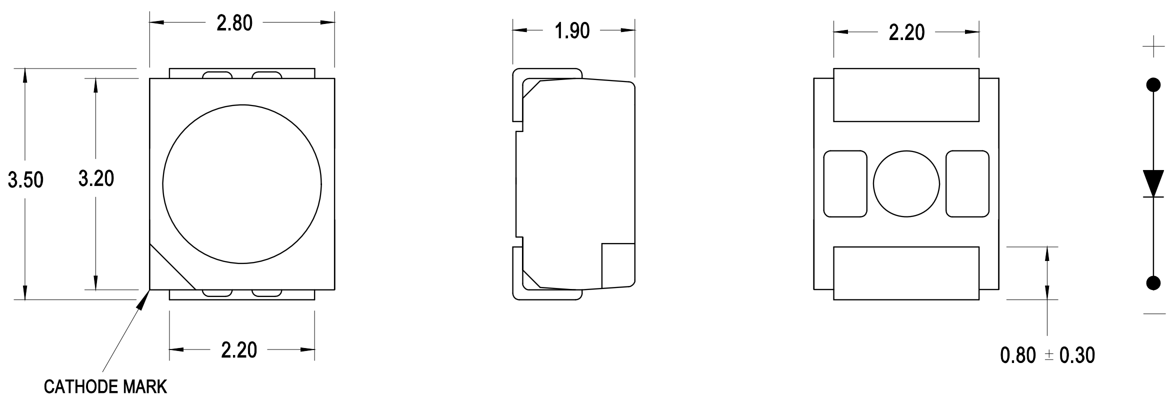
Applications

- Automotive interior lighting
  - Ambient lighting
  - Indicators and switches
  - Car door trim lighting
- Electronic signs and signals
  - Channel lettering
  - Contour lighting
  - Indoor variable message sign
- Office automations, home appliances, industrial equipment
  - Front panel backlighting
  - Push button backlighting
  - Display backlighting
  - Scanner lighting

CAUTION!

This LED is Class 2 ESD sensitive per ANSI/ESDA/JEDEC JS-001. Please observe appropriate precautions during handling and processing. Refer to application note AN-1142 for additional detail.

Figure 1: Package Drawing



NOTE:

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

Device Selection Guide (T_J = 25°C, I_F = 20mA)

Part Number	Correlated Color Temperature, CCT (Kelvin)	Luminous Intensity, I_V (mcd) [a, b]			Luminous Flux (lm) [c]
	Typ.	Min.	Typ.	Max.	Typ.
CSMM-CWG3-NX7A2	7000-10000	2240	2680	4500	8.0
CSMM-CWG3-NX7B2	5600-7000	2240	2680	4500	8.0
CSMM-CWG3-NX7C2	5000-5600	2240	2680	4500	8.0
CSMM-CWG3-NX7D2	4500-5000	2240	2680	4500	8.0

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 may not be aligned with the axis.

b. Tolerance is ±12%.

c. For reference only.

Absolute Maximum Ratings

Parameters	CSMM-CWG3-NX7x2	Unit
DC Forward Current [a]	30	mA
Peak Forward Current [b]	200	mA
Power Dissipation	96	mW
Reverse Voltage	5	V
LED Junction Temperature	125	°C
Operating Temperature Range	-40 to +100	°C
Storage Temperature Range	-40 to +100	°C

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

b. Duty factor = 10%, frequency = 1kHz, T_A=25°C.

Optical and Electrical Characteristics (T_J = 25°C, I_F = 20mA)

Parameters	Min.	Typ.	Max.	Unit
Viewing Angle, $2\theta_{½}$ [a]	–	120	–	°
Forward Voltage, V_F [b]	2.40	2.77	3.20	V
Reverse Current, I_R at V_R = 5V	–	–	10	µA
Color Rendering Index, CRI	80	–	–	–
Thermal Resistance, $R_{\theta J\text{-}S}$ [c]	–	100	–	°C/W

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

b. Forward voltage tolerance is ±0.1V.

c. Thermal resistance from LED junction to solder point.

Part Numbering System

C S M M – C W [x_1] 3 – N [x_2] [x_3] [x_4] [x_5]

Code	Description	Option	
x_1	Color Rendering Index	G	CRI ≥ 80
x_2	Minimum Intensity Bin	X	Minimum bin X
x_3	No of Intensity Bins	7	3 intensity sub bins, starting from bin X2
x_4	Color Bins	A	5K and 5L only
		B	6K and 6L only
		C	7K and 7L only
		D	8K and 8L only
x_5	Test Option	2	Test Current = 20mA

Part Number Example

CSMM-CWG3-NX7B2

x_1 : G – CRI ≥ 80

x_2 : X – Minimum intensity bin X

x_3 : 7 – 3 intensity sub bins, starting from sub bin X2

x_4 : B – Color bin 6Ka, 6Kb, 6Kc, 6Kd, 6La, 6Lb, 6Lc and 6Ld only

x_5 : 2 – Test current = 20mA

Bin Information

Intensity Bin Limits (CAT)

Bin ID	Luminous Intensity, I_V (mcd)	
	Min.	**Max.**
X2	2240	2850
Y1	2850	3550
Y2	3550	4500

Tolerance = ±12%

Example of bin information on reel and packaging label:

CAT : X2 – Intensity bin X2

BIN : 6La – Color bin 6La

VF : F05 – VF bin F05

Forward Voltage Bin Limits (VF)

Bin ID	Forward Voltage, V_F (V)	
	Min.	**Max.**
F03	2.4	2.6
F04	2.6	2.8
F05	2.8	3.0
F06	3.0	3.2

Tolerance = ±0.1V

Color Bin Limits (BIN)

CCT	Bin ID	Chromaticity Coordinates	
		x	y
7000K-10000K	5Ka	0.2960	0.2590
		0.3037	0.2702
		0.3018	0.2757
		0.2935	0.2635
	5Kb	0.2935	0.2635
		0.3018	0.2757
		0.2999	0.2811
		0.2910	0.2680
	5Kc	0.3037	0.2702
		0.3130	0.2840
		0.3115	0.2905
		0.3018	0.2757
	5Kd	0.3018	0.2757
		0.3115	0.2905
		0.3100	0.2970
		0.2999	0.2811
	5La	0.2910	0.2680
		0.2999	0.2811
		0.2976	0.2877
		0.2880	0.2735
	5Lb	0.2880	0.2735
		0.2976	0.2877
		0.2952	0.2943
		0.2850	0.2790
	5Lc	0.2999	0.2811
		0.3100	0.2970
		0.3085	0.3045
		0.2976	0.2877
	5Ld	0.2976	0.2877
		0.3085	0.3045
		0.3070	0.3120
		0.2952	0.2943

CCT	Bin ID	Chromaticity Coordinates	
		x	y
5600K-7000K	6Ka	0.3130	0.2840
		0.3215	0.2971
		0.3207	0.3053
		0.3115	0.2905
	6Kb	0.3115	0.2905
		0.3207	0.3053
		0.3199	0.3135
		0.3100	0.2970
	6Kc	0.3215	0.2971
		0.3300	0.3100
		0.3300	0.3200
		0.3207	0.3053
	6Kd	0.3207	0.3053
		0.3300	0.3200
		0.3300	0.3300
		0.3199	0.3135
	6La	0.3100	0.2970
		0.3199	0.3135
		0.3192	0.3215
		0.3085	0.3045
	6Lb	0.3085	0.3045
		0.3192	0.3215
		0.3184	0.3294
		0.3070	0.3120
	6Lc	0.3199	0.3135
		0.3300	0.3300
		0.3300	0.3385
		0.3192	0.3215
	6Ld	0.3192	0.3215
		0.3300	0.3385
		0.3300	0.3470
		0.3184	0.3294

CCT	Bin ID	Chromaticity Coordinates	
		x	y
5000K-5600K	7Ka	0.3300	0.3100
		0.3362	0.3202
		0.3366	0.3304
		0.3300	0.3200
	7Kb	0.3300	0.3200
		0.3366	0.3304
		0.3370	0.3406
		0.3300	0.3300
	7Kc	0.3362	0.3202
		0.3433	0.3307
		0.3442	0.3414
		0.3366	0.3304
	7Kd	0.3366	0.3304
		0.3442	0.3414
		0.3450	0.3520
		0.3370	0.3406
	7La	0.3300	0.3300
		0.3370	0.3406
		0.3374	0.3494
		0.3300	0.3385
	7Lb	0.3300	0.3385
		0.3374	0.3494
		0.3377	0.3581
		0.3300	0.3470
	7Lc	0.3370	0.3406
		0.3450	0.3520
		0.3460	0.3615
		0.3374	0.3494
	7Ld	0.3374	0.3494
		0.3460	0.3615
		0.3470	0.3710
		0.3377	0.3581

CCT	Bin ID	Chromaticity Coordinates	
		x	y
4500K-5000K	8Ka	0.3433	0.3307
		0.3506	0.3426
		0.3521	0.3535
		0.3442	0.3414
	8Kb	0.3442	0.3414
		0.3521	0.3535
		0.3535	0.3644
		0.3450	0.3520
	8Kc	0.3521	0.3535
		0.3506	0.3426
		0.3600	0.3570
		0.3620	0.3685
	8Kd	0.3521	0.3535
		0.3620	0.3685
		0.3640	0.3800
		0.3535	0.3644
	8La	0.3450	0.3520
		0.3535	0.3644
		0.3549	0.3746
		0.3460	0.3615
	8Lb	0.3460	0.3615
		0.3549	0.3746
		0.3562	0.3847
		0.3470	0.3710
	8Lc	0.3535	0.3644
		0.3640	0.3800
		0.3655	0.3905
		0.3549	0.3746
	8Ld	0.3549	0.3746
		0.3655	0.3905
		0.3670	0.4010
		0.3562	0.3847

Tolerance = ±0.01

Figure 2: Chromaticity Diagram

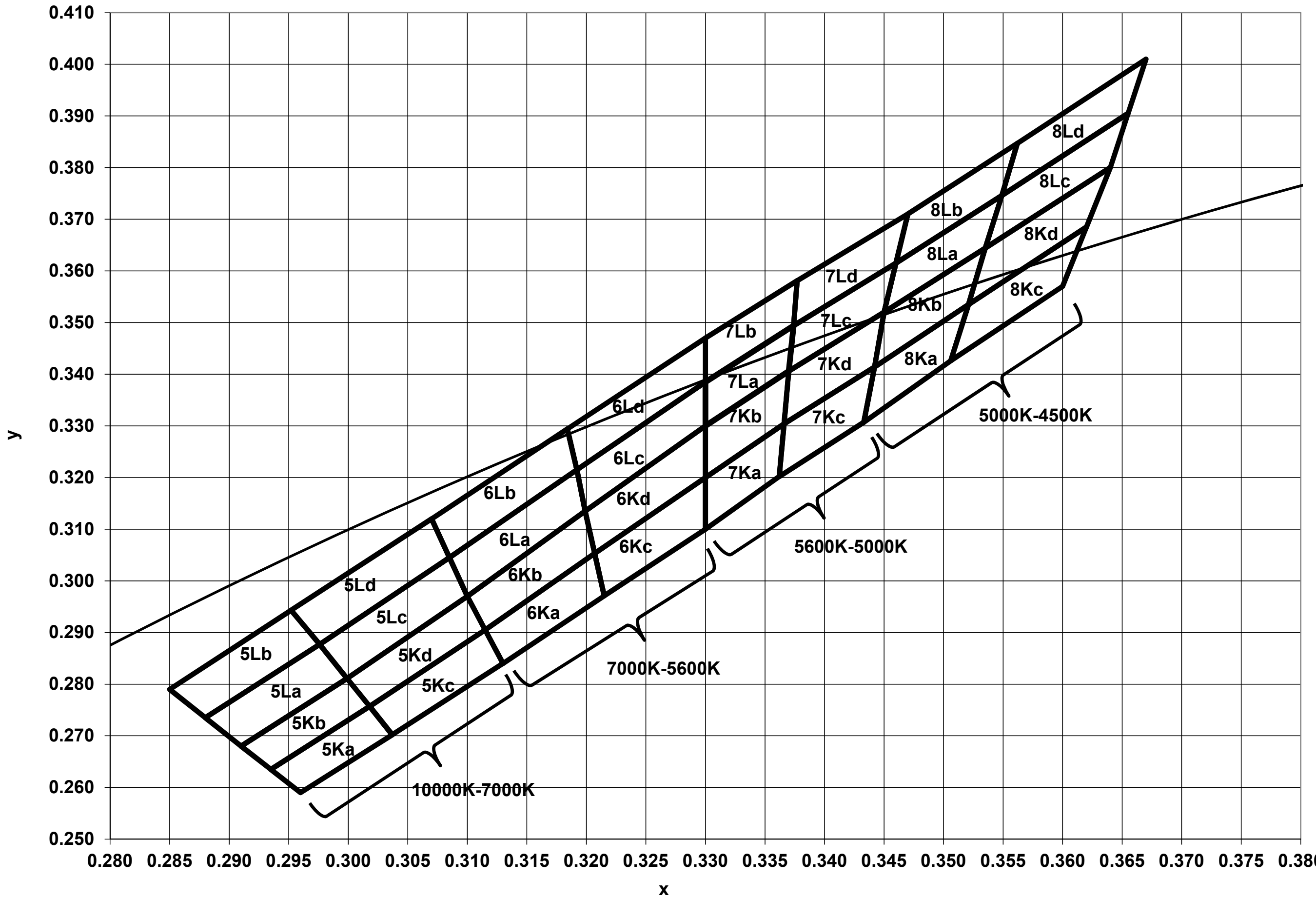


Figure 3: Spectral Power Distribution

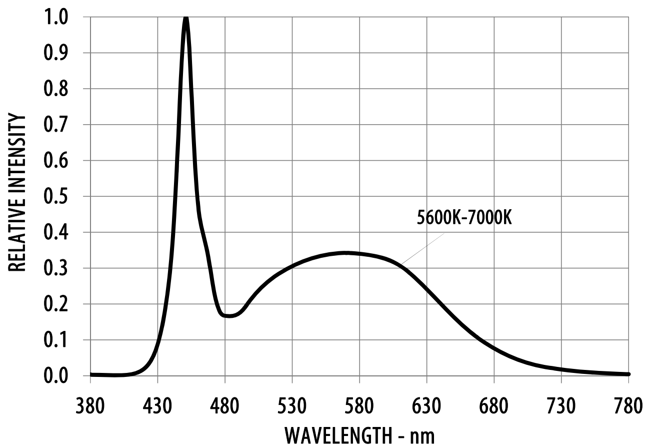


Figure 4: Forward Current vs. Forward Voltage

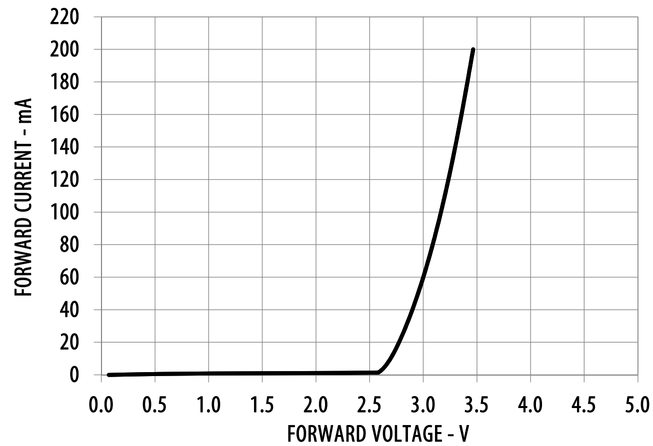


Figure 5: Relative Luminous Intensity vs. Mono Pulse Current

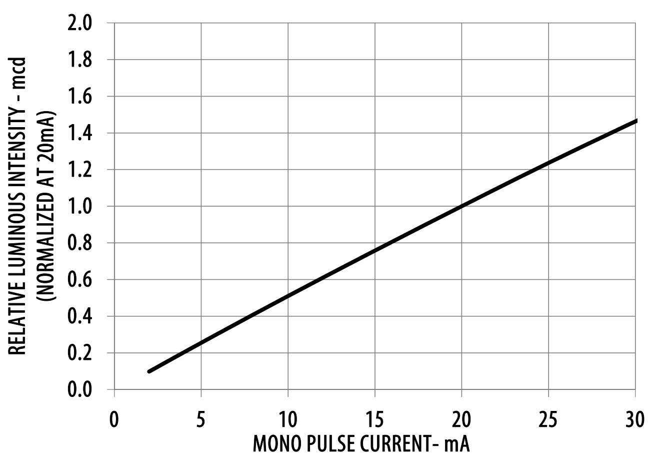


Figure 6: Radiation Pattern

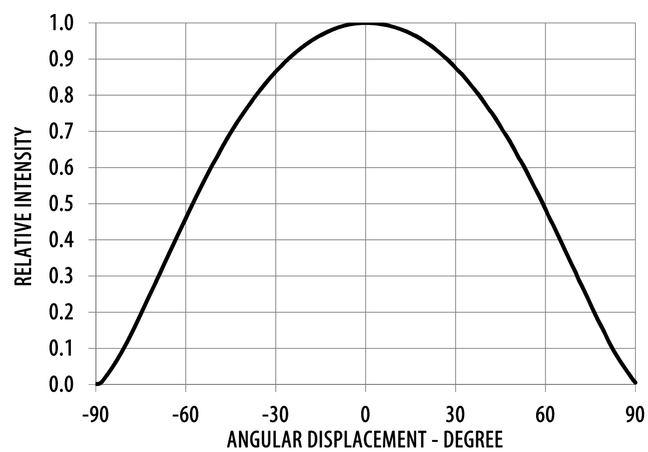


Figure 7: Chromaticity Coordinate Shift vs. Mono Pulse Current (5600K-7000K)

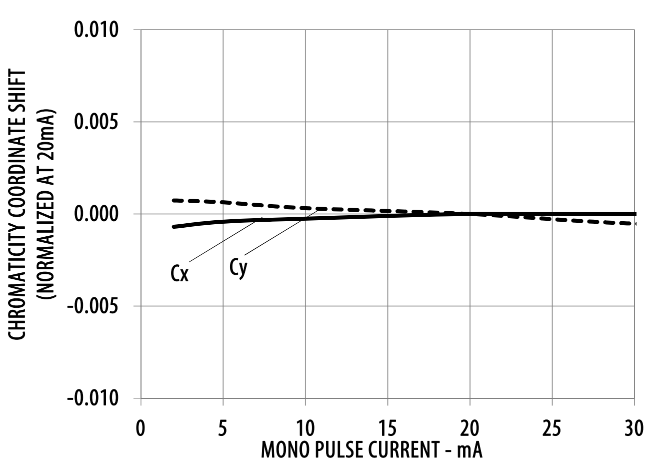


Figure 8: Forward Voltage Shift vs. Junction Temperature

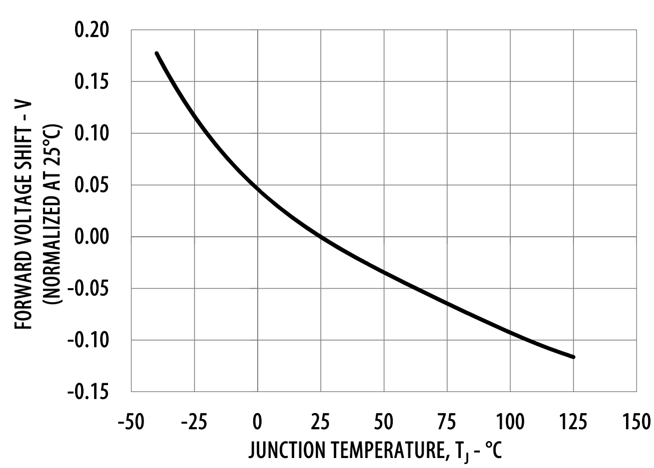


Figure 9: Relative Luminous Intensity vs. Junction Temperature

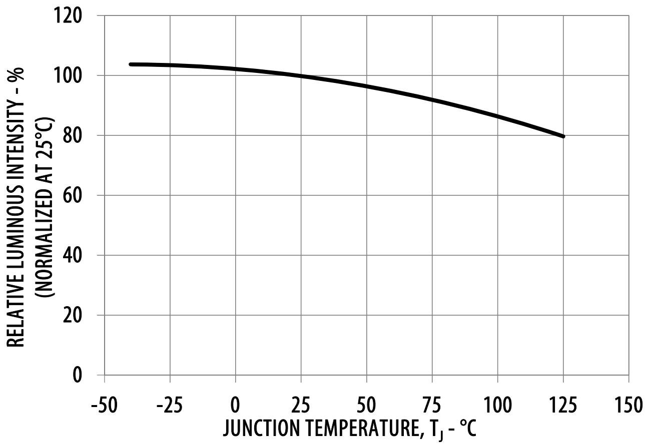


Figure 10: Chromaticity Coordinate Shift vs. Junction Temperature(5600K-7000K)

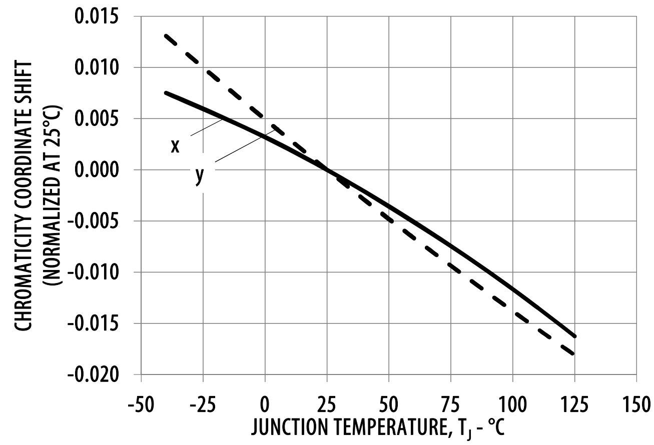


Figure 11: Maximum Forward Current vs. Ambient Temperature. Derated based on T_{JMAX} = 125°C

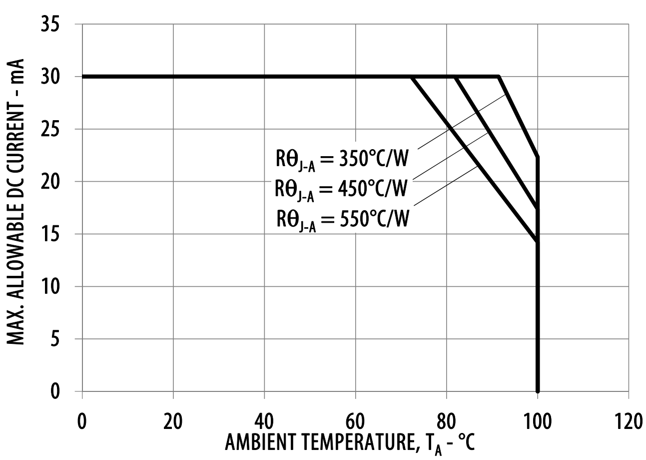


Figure 12: Maximum Forward Current vs. Solder Point Temperature. Derated based on T_{JMAX} = 125°C, $R_{\theta J-S}$ = 100°C/W

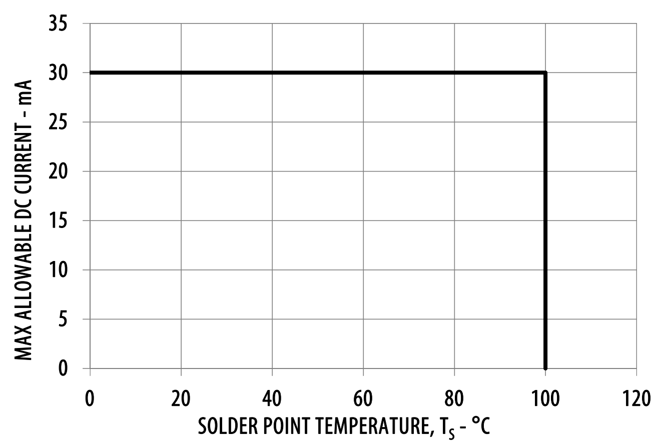
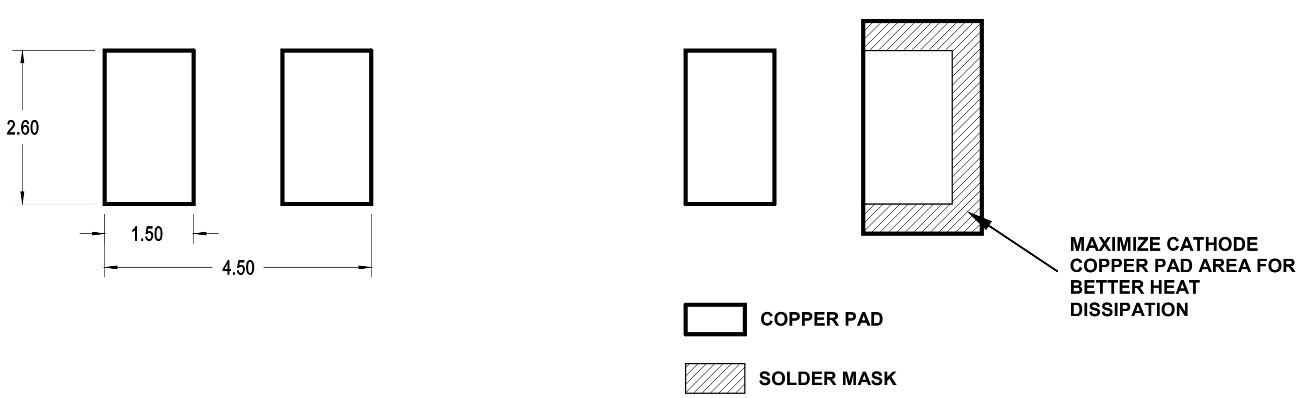
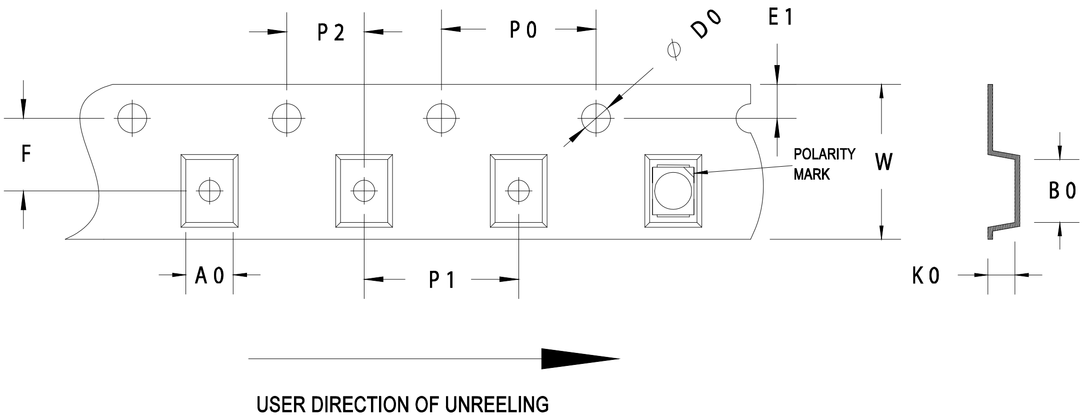


Figure 13: Recommended Soldering Land Pattern



NOTE: All dimensions are in millimeters (mm).

Figure 14: Carrier Tape Dimensions



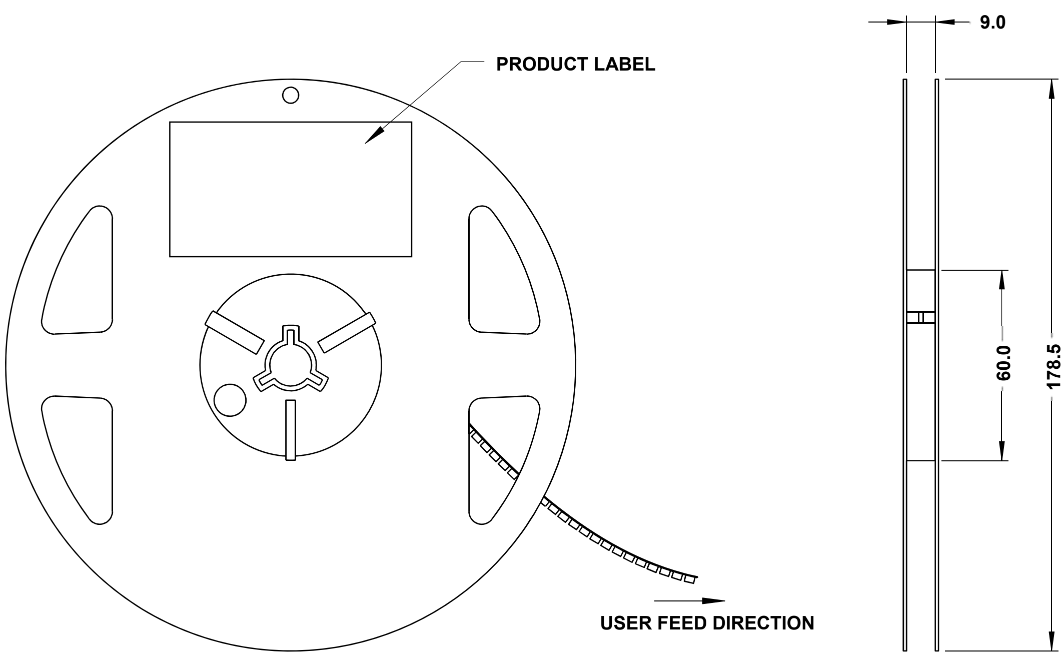
F	P0	P1	P2	D0	E1	W
3.5±0.1	4.0±0.1	4.0±0.1	2.0±0.05	1.55±0.05	1.75±0.1	8.0±0.2

B0	K0	A0
3.85±0.1	2.15±0.1	3.1±0.1

NOTE:

1. All dimensions in millimeters (mm).

Figure 15: Reel Dimensions



NOTE: All dimensions are in millimeters (mm).

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 = 3sec 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 16: Recommended Lead-Free Reflow Soldering Profile

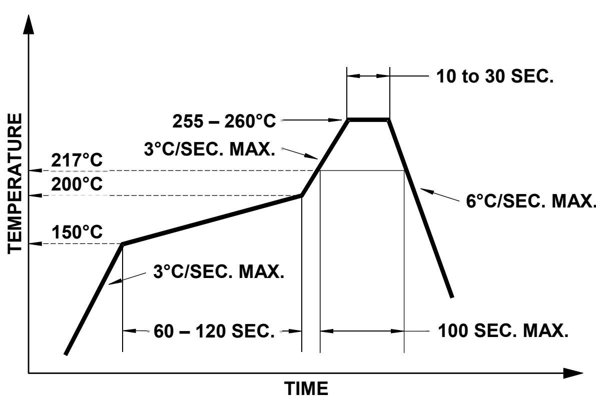
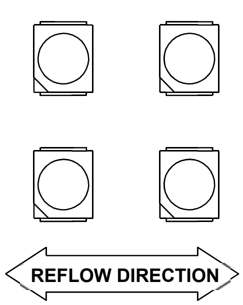


Figure 17: Recommended Board Reflow Direction



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 an outer diameter of 3.5mm 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 Devices

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±5ºC 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 may 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.
- 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 may affect the optical characteristics and product life.
- White LEDs must not be exposed to acidic environments and must not be used in the vicinity of any compound that may have acidic outgas, such as, but not limited to, acrylate adhesive. These environments have an adverse effect on LED performance.
- 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, 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. $R_{\theta J\text{-}A}$ 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:

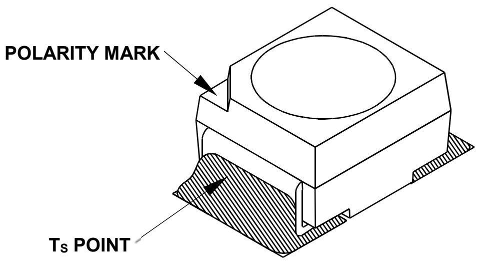
T_S = LED solder point temperature as shown in the following figure (°C)

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

I_F = forward current (A)

V_{Fmax} = maximum forward voltage (V)

Figure 18: 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 the 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 the 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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