

CSMW-LWG0-NxxxE

Mid-Power 2835 DFN-2 Surface-Mount LED

Description

The Broadcom® CSMW-LWG0-NxxxE surface-mount LEDs use InGaN chip technology with superior package design to enable them to produce higher light output with better flux performance. They can be driven at high current and 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 them ideal for various applications including fluorescent replacement, under cabinet lighting, retail display lighting, and panel lights.

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.

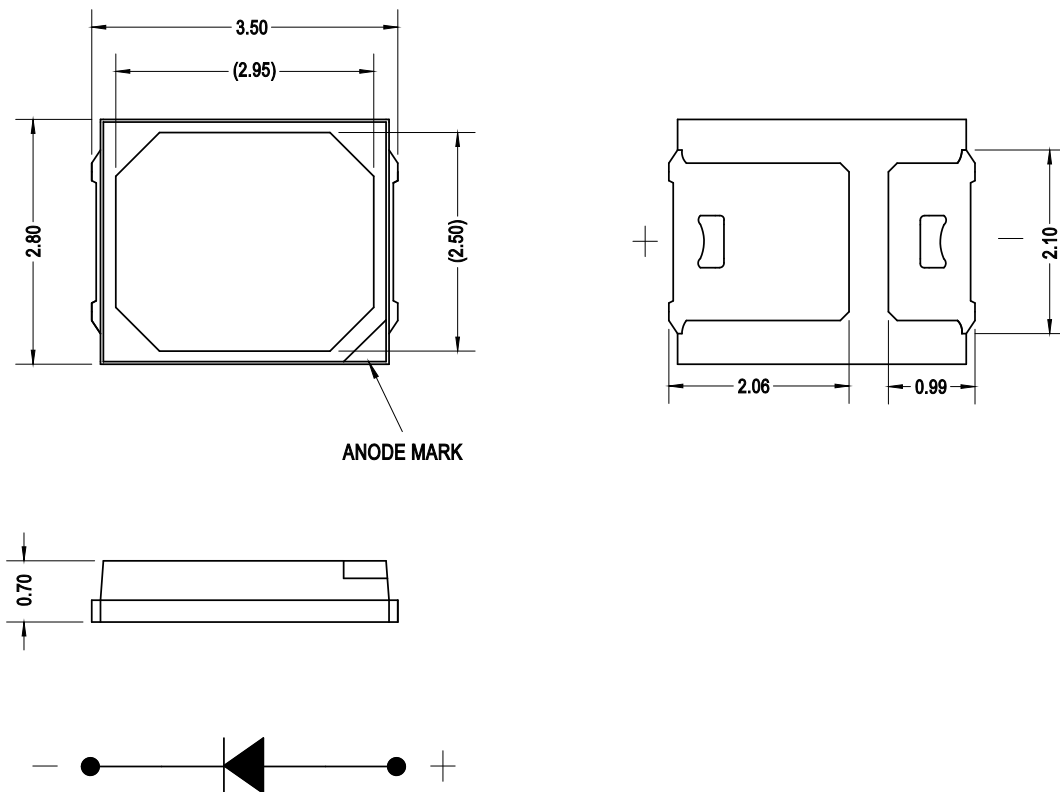
Features

- High reliability package with enhanced silicone resin encapsulation
- Available in 2700K, 3000K, 3500K, 4000K, 4500K, 5000K, 5700K, 6500K, and 8000K CCT only
- Low package profile and large emitting area for better uniformity in linear lighting
- Enhanced corrosion resistance
- Product qualified as per AEC-Q101 guidelines

Applications

- Automotive interior lighting
 - Compartment light
 - Cabin light
 - Reading light
- Automotive exterior lighting
 - License plate illumination
 - Puddle lamp
 - Reverse light
 - Side marker light
- Channel letter and advertisement board backlighting
- Office automations, home appliances, industrial equipment, and indicator lighting

CAUTION! This LED is ESD sensitive. Observe appropriate precautions during handling and processing. Refer to application note AN-1142 for additional details.

Figure 1: Package Drawing**NOTE:**

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

Device Selection Guide ($T_J = 25^\circ\text{C}$, $I_F = 150\text{ mA}$)

Part Number	Correlated Color Temperature, CCT (Kelvin)	Luminous Flux, Φ_V (lm) ^{a,b}			Luminous Intensity (cd) ^c
	Typ.	Min.	Typ.	Max.	
CSMW-LWG0-NS0AE	8000	51.0	61.0	—	20.3
CSMW-LWG0-NS0BE	6500	51.0	64.0	—	21.3
CSMW-LWG0-NS0CE	5700	51.0	64.0	—	21.3
CSMW-LWG0-NS0DE	5000	51.0	65.0	—	21.7
CSMW-LWG0-NS0EE	4500	51.0	65.0	—	21.7
CSMW-LWG0-NS0FE	4000	51.0	65.0	—	21.7
CSMW-LWG0-NS0GE	3500	51.0	58.0	—	19.3
CSMW-LWG0-NR0HE	3000	42.8	58.0	—	19.3
CSMW-LWG0-NR0JE	2700	42.8	58.0	—	19.3
CSMW-LWG0-NSUAE	8000	51.0	61.0	85.6	20.3
CSMW-LWG0-NSUBE	6500	51.0	64.0	85.6	21.3
CSMW-LWG0-NSUCE	5700	51.0	64.0	85.6	21.3
CSMW-LWG0-NSUDE	5000	51.0	65.0	85.6	21.7
CSMW-LWG0-NSTDE	5000	51.0	65.0	72.0	21.7
CSMW-LWG0-NSUEE	4500	51.0	65.0	85.6	21.7
CSMW-LWG0-NSUFE	4000	51.0	65.0	85.6	21.7
CSMW-LWG0-NSUGE	3500	51.0	58.0	85.6	19.3
CSMW-LWG0-NRTHE	3000	42.8	58.0	72.0	19.3
CSMW-LWG0-NRTJE	2700	42.8	58.0	72.0	19.3
CSMW-LWG0-NSULE	5700K to 6500K	51.0	64.0	72.0	21.3

a. The luminous flux, Φ_V , is measured at the mechanical axis of the package and it is tested with a single current pulse condition.

b. Tolerance is $\pm 12\%$.

c. For reference only.

Absolute Maximum Ratings

Parameters	CSMW-LWG0-NxxxE	Unit
DC Forward Current ^a	240	mA
Peak Forward Current ^b	350	mA
Power Dissipation	864	mW
Reverse Voltage	Not designed for reverse bias operation	
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 14](#) and [Figure 15](#).

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

Optical and Electrical Characteristics ($T_J = 25^{\circ}\text{C}$, $I_F = 150\text{ mA}$)

Parameters	Min.	Typ.	Max.	Unit
Viewing Angle, $2\theta_{1/2}$ ^a	—	120	—	°
Forward Voltage, V_F ^b	2.80	3.22	3.60	V
Reverse Current, I_R at $V_R = 5\text{V}$ ^c	—	—	10	μA
Color Rendering Index, CRI	—	80	—	—
Thermal Resistance, $R_{\theta J-S}$ ^d	—	47	—	°C/W

a. $\theta_{1/2}$ is the off-axis angle where the luminous intensity is half of the peak intensity.

b. Forward voltage tolerance is $\pm 0.1\text{V}$.

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

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

Performance Characteristics ($T_J = 25^\circ\text{C}$)

Forward Current (mA)	Relative Luminous Flux (Normalized at 150 mA)	Luminous Flux, Φ_V (lm)	Forward Voltage, V_F (V)	Luminous Efficiency (lm/W)
		Typ.	Typ.	Typ.
CSMW-LWG0-NS0AE, CSMW-LWG0-NSUAE				
65	0.496	30.2	2.93	159.1
80	0.596	36.4	2.98	152.3
100	0.723	44.1	3.06	144.3
120	0.838	51.1	3.12	136.4
150 (Test Current)	1.000	61.0	3.22	126.2
200	1.244	75.9	3.38	112.4
240	1.415	86.3	3.50	102.8
CSMW-LWG0-NS0BE, CSMW-LWG0-NS0CE CSMW-LWG0-NSUBE, CSMW-LWG0-NSUCE				
65	0.496	31.7	2.93	166.9
80	0.596	38.1	2.98	159.8
100	0.723	46.3	3.06	151.4
120	0.838	53.6	3.12	143.1
150 (Test Current)	1.000	64.0	3.22	132.4
200	1.244	79.6	3.38	117.9
240	1.415	90.6	3.50	107.9
CSMW-LWG0-NS0DE, CSMW-LWG0-NS0EE, CSMW-LWG0-NS0FE CSMW-LWG0-NSTDE CSMW-LWG0-NSUDE, CSMW-LWG0-NSUEE, CSMW-LWG0-NSUFE				
65	0.496	32.2	2.93	169.5
80	0.596	38.7	2.98	162.3
100	0.723	47.0	3.06	153.8
120	0.838	54.5	3.12	145.3
150 (Test Current)	1.000	65.0	3.22	134.5
200	1.244	80.9	3.38	119.8
240	1.415	92.0	3.50	109.6
CSMW-LWG0-NS0GE, CSMW-LWG0-NR0HE, CSMW-LWG0-NR0JE CSMW-LWG0-NSUGE, CSMW-LWG0-NRTHE, CSMW-LWGO-NRTJE				
65	0.496	28.8	2.93	151.2
80	0.596	34.6	2.98	144.8
100	0.723	41.9	3.06	137.2
120	0.838	48.6	3.12	129.7
150 (Test Current)	1.000	58.0	3.22	120.0
200	1.244	72.2	3.38	106.9
240	1.415	82.1	3.50	97.8

Part Numbering System

C S M W - L W G 0 - N

x ₁	x ₂	x ₃	x ₄
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Code	Description	Option	
x ₁	Minimum Flux Bin	Refer to Flux Bin Limits (CAT) table	
x ₂	Maximum Flux Bin		
x ₃	Color Correlated Temperature	A	8000K
		B	6500K
		C	5700K
		D	5000K
		E	4500K
		F	4000K
		G	3700K
		H	3000K
		J	2700K
		K	6500K to 8000K
		L	5700K to 6500K
		M	5000K to 5700K
		N	4500K to 5000K
		Q	3500K to 4000K
		R	3000K to 3500K
		S	2700K to 3000K
		0	4500k to 8000K
		1	2700K to 4000K
x ₄	Test Option	E	Test Current = 150 mA

Part Number Example

CSMW-LWG0-NSUDE

x₁: S – Minimum flux bin S
 x₂: T – Maximum flux bin U
 x₃: D – CCT 5000K with bin ID 4A, 4B, 4C, 4D
 x₄: E – Test current = 150 mA

Bin Information

Flux Bin Limits (CAT)

Bin ID	Luminous Flux, Φ_V (lm)	
	Min.	Max.
R	42.8	51.0
S	51.0	60.5
T	60.5	72.0
U	72.0	85.6
0	Full Bin Distribution	

Tolerance = $\pm 12\%$.

Example of bin information on reel and packaging label:

CAT: S – Flux bin S
 BIN: 4A – Color bin 4A
 VF: F06 – VF bin F06

Forward Voltage Bin Limits (VF)

Bin ID	Forward Voltage, V_F (V)	
	Min.	Max.
F05	2.8	3.0
F06	3.0	3.2
F07	3.2	3.4
F08	3.4	3.6

Tolerance = $\pm 0.1V$.

Color Bin Limits (BIN)

Table 1: Chromaticity Coordinates: 8000K, 6500K, 5700K

CCT	Bin ID	Chromaticity Coordinates		CCT	Bin ID	Chromaticity Coordinates		CCT	Bin ID	Chromaticity Coordinates	
		x	y			x	y			x	y
8000K	1A	0.2950	0.2970	6500K	2A	0.3048	0.3207	5700K	3A	0.3215	0.3350
		0.2920	0.3060			0.3130	0.3290			0.3290	0.3417
		0.2984	0.3133			0.3144	0.3186			0.3290	0.3300
		0.3009	0.3042			0.3068	0.3113			0.3222	0.3243
	1B	0.2920	0.3060		2B	0.3028	0.3304		3B	0.3207	0.3462
		0.2895	0.3135			0.3115	0.3391			0.3290	0.3538
		0.2962	0.3220			0.3130	0.3290			0.3290	0.3417
		0.2984	0.3133			0.3048	0.3207			0.3215	0.3350
	1C	0.2984	0.3133		2C	0.3115	0.3391		3C	0.3290	0.3538
		0.2962	0.3220			0.3205	0.3481			0.3376	0.3616
		0.3028	0.3304			0.3213	0.3373			0.3371	0.3490
		0.3048	0.3207			0.3130	0.3290			0.3290	0.3417
	1D	0.2984	0.3133		2D	0.3130	0.3290		3D	0.3290	0.3417
		0.3048	0.3207			0.3213	0.3373			0.3371	0.3490
		0.3068	0.3113			0.3221	0.3261			0.3366	0.3369
		0.3009	0.3042			0.3144	0.3186			0.3290	0.3300

Table 2: Chromaticity Coordinates: 5000K, 4500K, 4000K

CCT	Bin ID	Chromaticity Coordinates		CCT	Bin ID	Chromaticity Coordinates		CCT	Bin ID	Chromaticity Coordinates	
		x	y			x	y			x	y
5000K	4A	0.3371	0.3490	4500K	5A	0.3530	0.3597	4000K	6A	0.3670	0.3578
		0.3451	0.3554			0.3615	0.3659			0.3702	0.3722
		0.3440	0.3427			0.3590	0.3521			0.3825	0.3798
		0.3366	0.3369			0.3512	0.3465			0.3783	0.3646
	4B	0.3376	0.3616		5B	0.3548	0.3736		6B	0.3702	0.3722
		0.3463	0.3687			0.3641	0.3804			0.3736	0.3874
		0.3451	0.3554			0.3615	0.3659			0.3869	0.3958
		0.3371	0.3490			0.3530	0.3597			0.3825	0.3798
	4C	0.3463	0.3687		5C	0.3641	0.3804		6C	0.3825	0.3798
		0.3551	0.3760			0.3736	0.3874			0.3869	0.3958
		0.3533	0.3620			0.3702	0.3722			0.4006	0.4044
		0.3451	0.3554			0.3615	0.3659			0.3950	0.3875
	4D	0.3451	0.3554		5D	0.3615	0.3659		6D	0.3783	0.3646
		0.3533	0.3620			0.3702	0.3722			0.3825	0.3798
		0.3515	0.3487			0.3670	0.3578			0.3950	0.3875
		0.3440	0.3427			0.3590	0.3521			0.3898	0.3716

Table 3: Chromaticity Coordinates: 3500K, 3000K, 2700K

CCT	Bin ID	Chromaticity Coordinates		CCT	Bin ID	Chromaticity Coordinates		CCT	Bin ID	Chromaticity Coordinates	
		x	y			x	y			x	y
3500K	7A	0.3889	0.3690	3000K	8A	0.4147	0.3814	2700K	9A	0.4373	0.3893
		0.3941	0.3848			0.4221	0.3984			0.4465	0.4071
		0.4080	0.3916			0.4342	0.4028			0.4582	0.4099
		0.4017	0.3751			0.4259	0.3853			0.4483	0.3919
	7B	0.3941	0.3848		8B	0.4221	0.3984		9B	0.4465	0.4071
		0.3996	0.4015			0.4299	0.4165			0.4562	0.4260
		0.4146	0.4089			0.4430	0.4212			0.4687	0.4289
		0.4080	0.3916			0.4342	0.4028			0.4582	0.4099
	7C	0.4080	0.3916		8C	0.4342	0.4028		9C	0.4582	0.4099
		0.4146	0.4089			0.4430	0.4212			0.4687	0.4289
		0.4299	0.4165			0.4562	0.4260			0.4813	0.4319
		0.4221	0.3984			0.4465	0.4071			0.4700	0.4126
	7D	0.4017	0.3751		8D	0.4259	0.3853		9D	0.4483	0.3919
		0.4080	0.3916			0.4342	0.4028			0.4582	0.4099
		0.4221	0.3984			0.4465	0.4071			0.4700	0.4126
		0.4147	0.3814			0.4373	0.3893			0.4593	0.3944

Tolerance = ± 0.01 .

Figure 2: Chromaticity Diagram

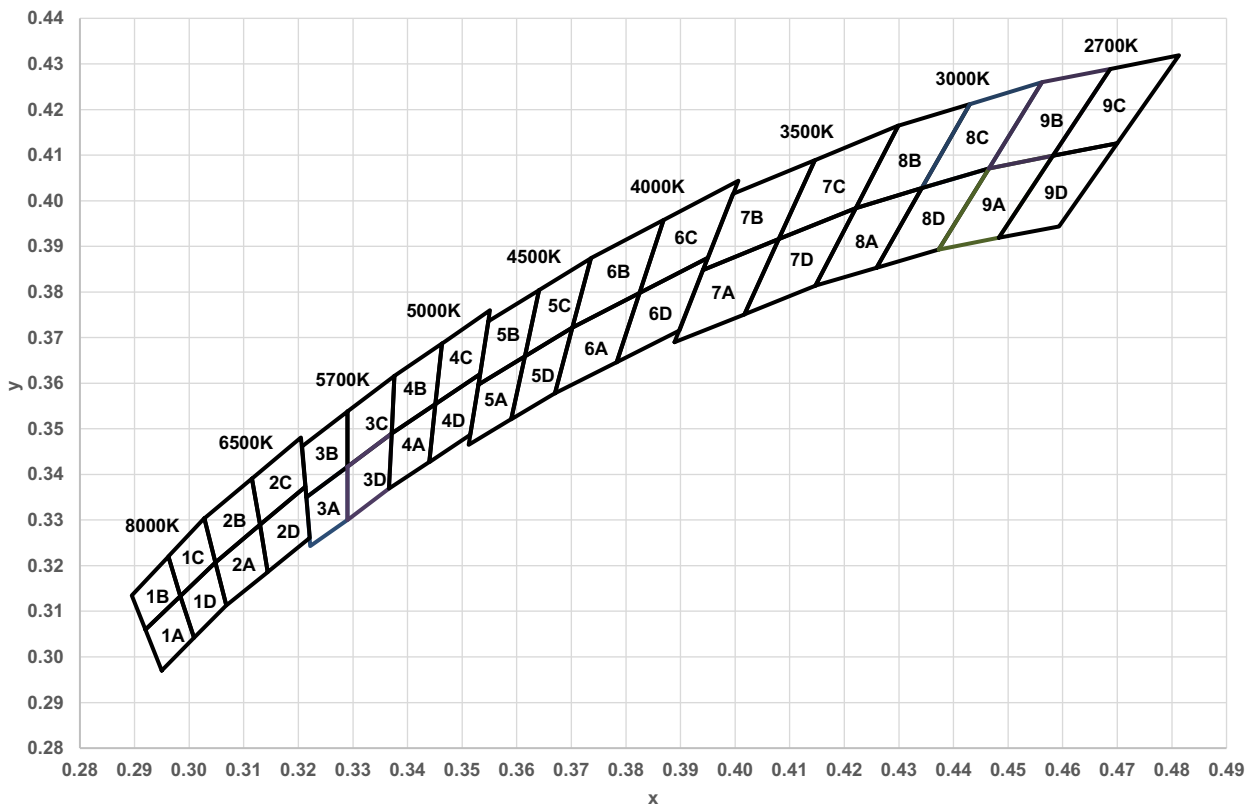


Figure 3: Spectral Power Distribution

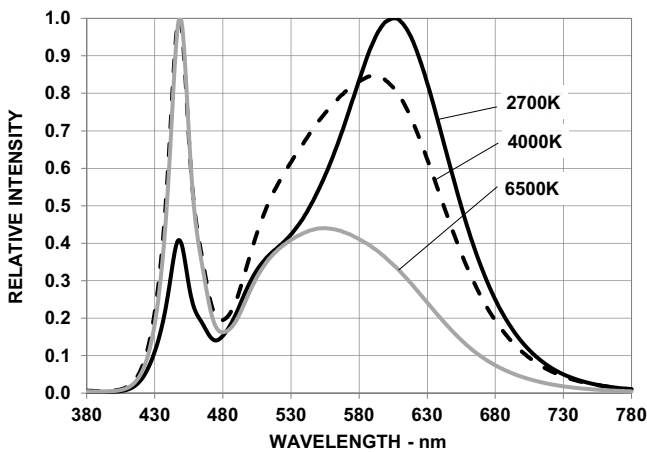


Figure 4: Forward Current vs. Forward Voltage

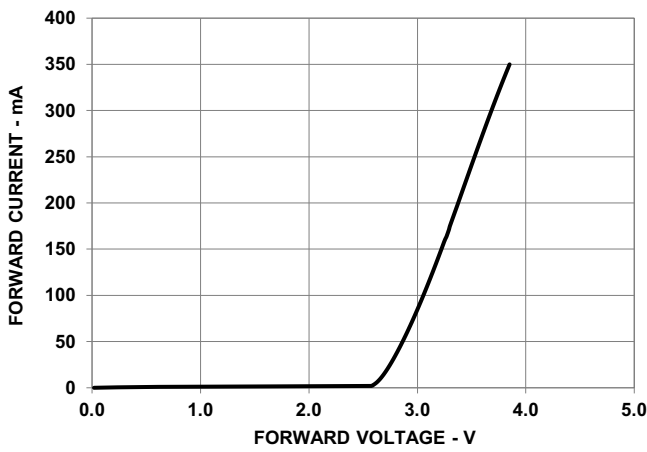


Figure 5: Relative Luminous Flux vs. Mono Pulse Current

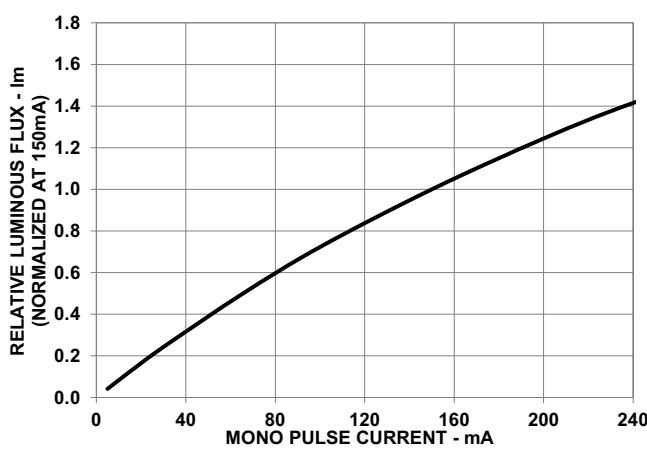


Figure 6: Radiation Pattern

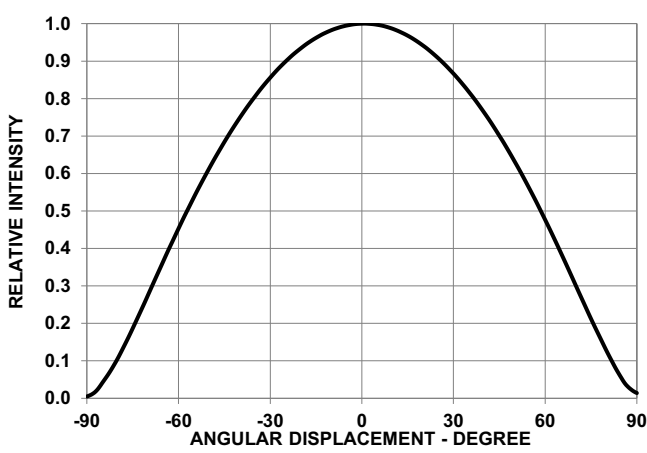


Figure 7: Chromaticity Coordinate Shift vs. Mono Pulse Current, 2700K

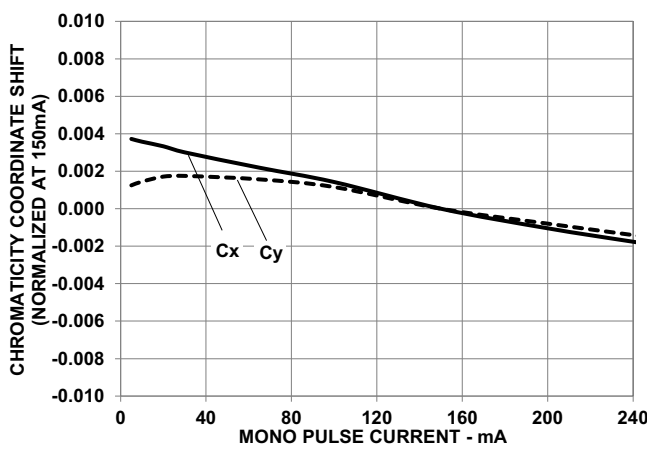


Figure 8: Chromaticity Coordinate Shift vs. Mono Pulse Current, 4000K

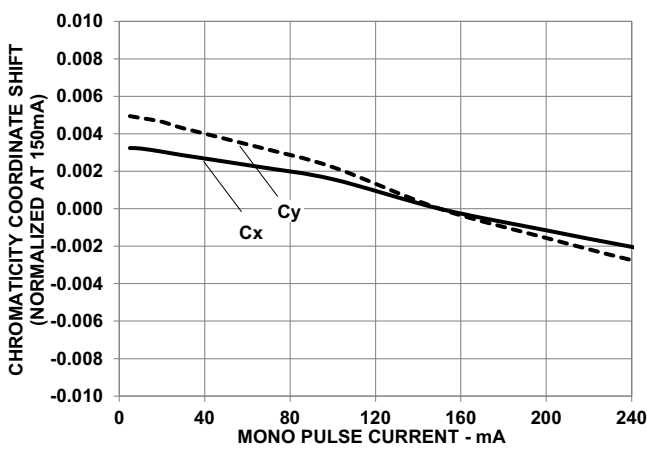


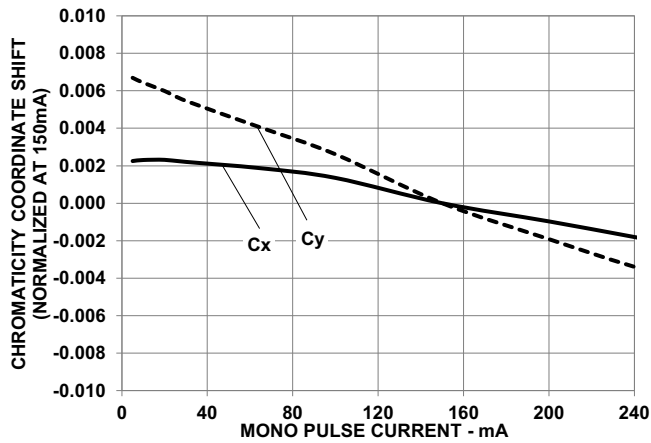
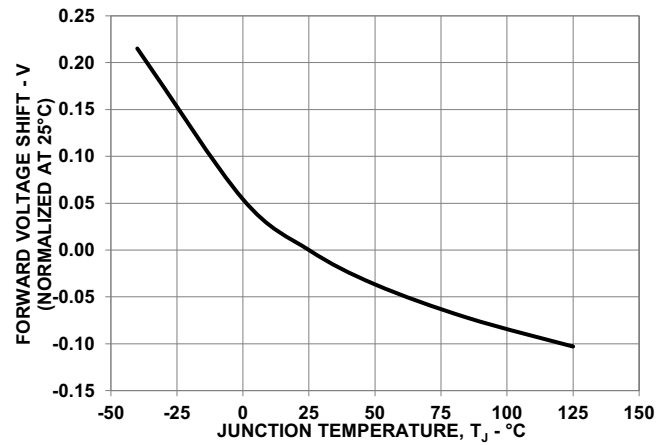
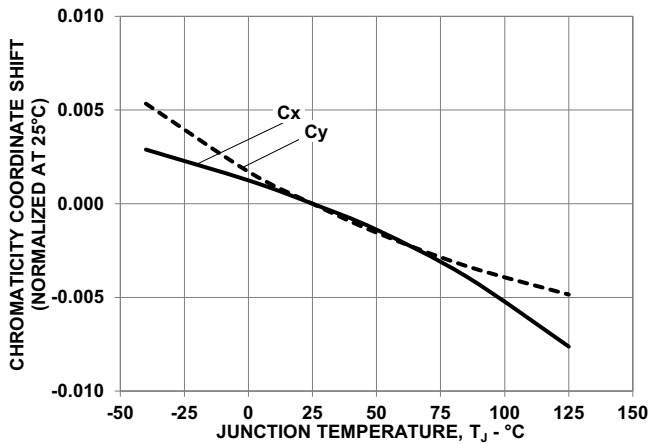
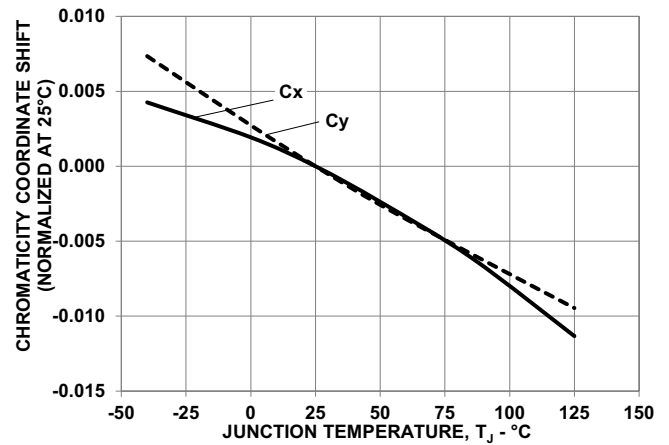
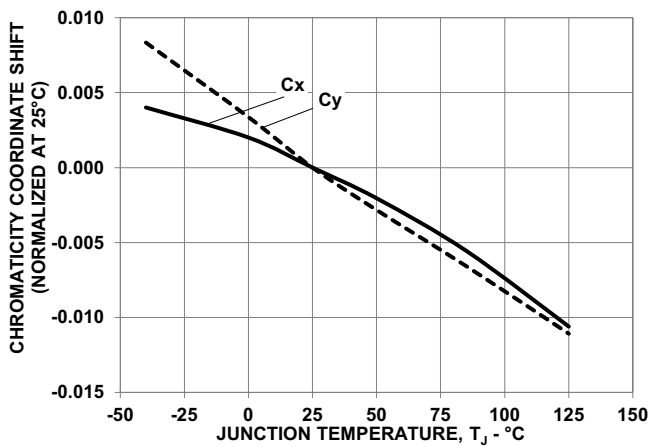
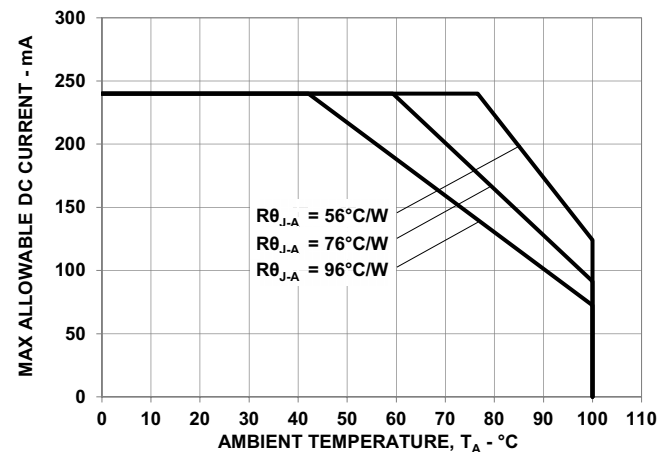
Figure 9: Chromaticity Coordinate Shift vs. Mono Pulse Current, 6500K**Figure 10: Forward Voltage Shift vs. Junction Temperature****Figure 11: Chromaticity Coordinate Shift vs. Junction Temperature, 2700K****Figure 12: Chromaticity Coordinate Shift vs. Junction Temperature, 4000K****Figure 13: Chromaticity Coordinate Shift vs. Junction Temperature, 6500K****Figure 14: Maximum Forward Current vs. Ambient Temperature. Derated Based on $T_{JMAX} = 125^{\circ}\text{C}$** 

Figure 15: Maximum Forward Current vs. Solder Point Temperature. Derated Based on $T_{JMAX} = 125^{\circ}\text{C}$, $R_{\theta J-S} = 47^{\circ}\text{C/W}$

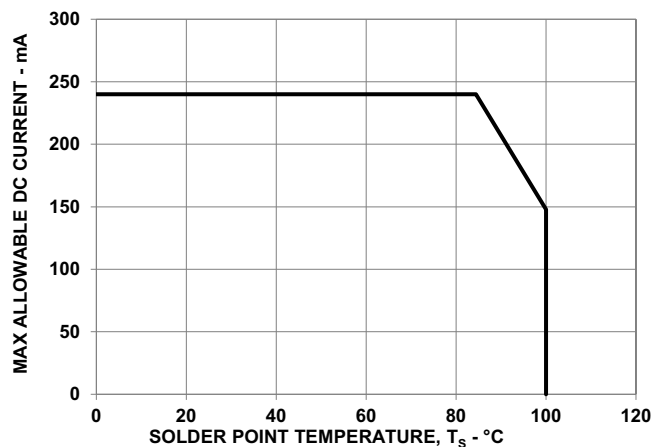


Figure 16: Pulse Handling Capability at $T_s \leq 80^{\circ}\text{C}$

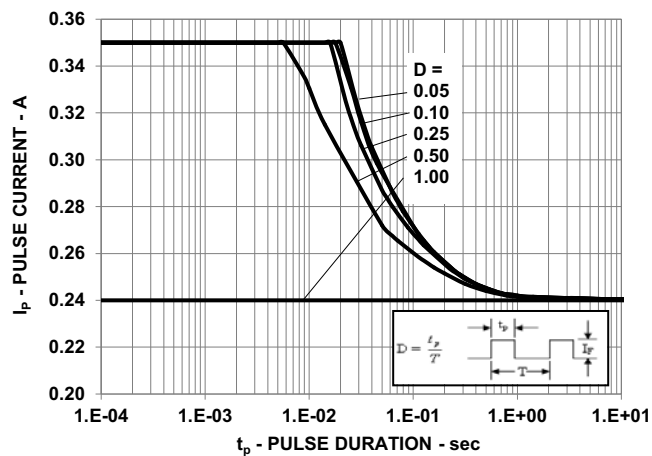


Figure 17: Pulse Handling Capability at $T_s = 100^{\circ}\text{C}$

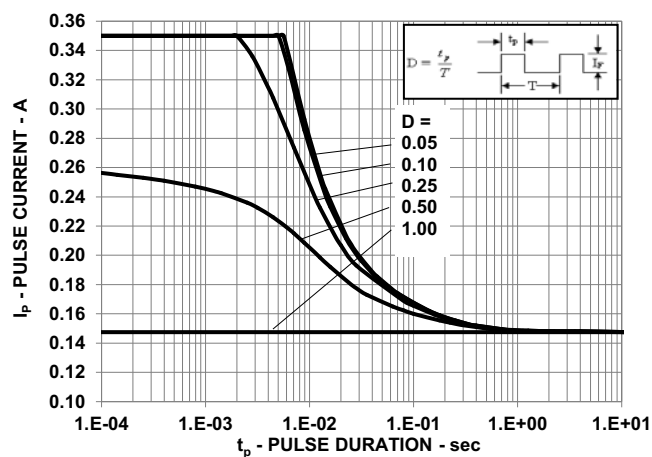
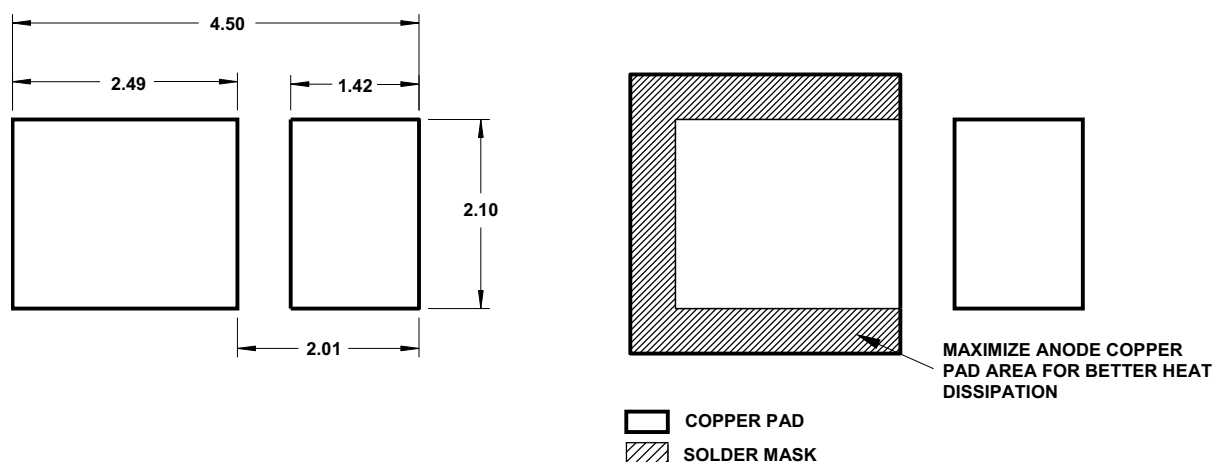
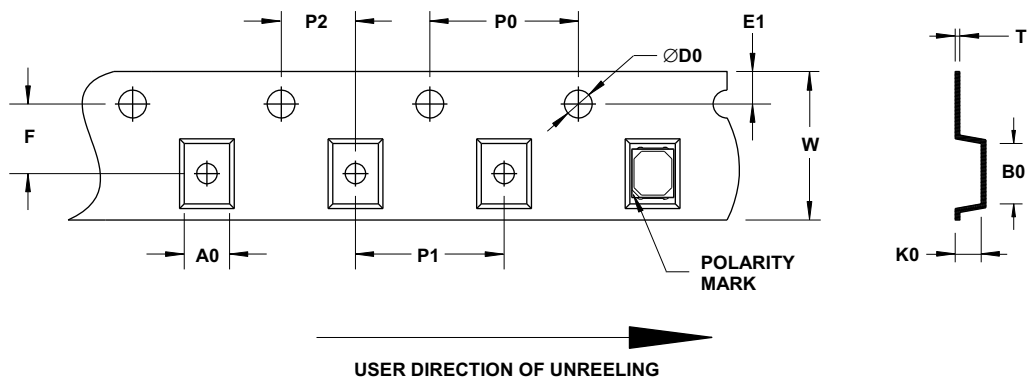


Figure 18: Recommended Soldering Land Pattern



NOTE: All dimensions are in millimeters (mm).

Figure 19: Carrier Tape Dimensions

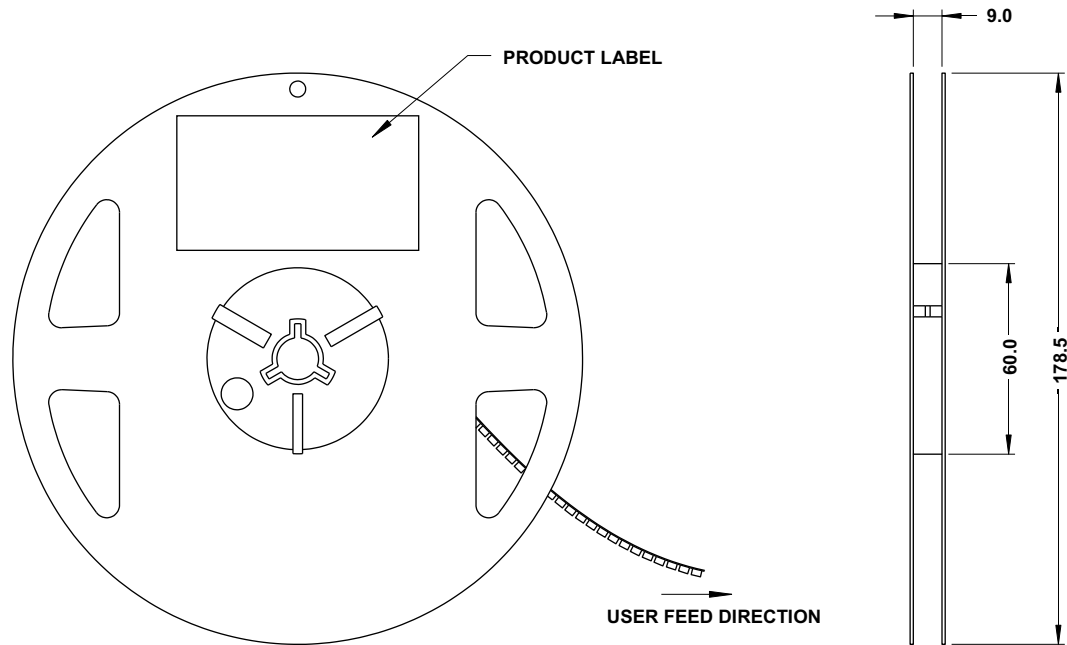


F	P0	P1	P2	D0	E1	W
3.5±0.05	4.0±0.1	4.0±0.1	2.0±0.05	1.55±0.05	1.75±0.1	8.0±0.2

T	B0	K0	A0
0.2±0.05	3.8±0.1	1.05±0.1	3.1±0.1

NOTE: All dimensions are in millimeters (mm).

Figure 20: 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 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 is affected by soldering with hand soldering.

Figure 21: Recommended Lead-Free Reflow Soldering Profile

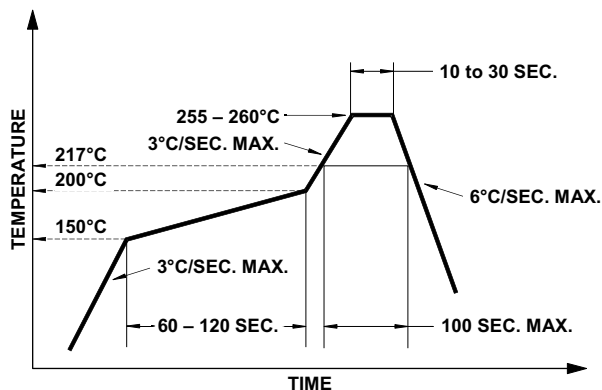
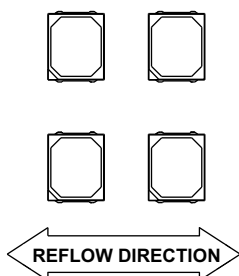


Figure 22: Recommended Board Reflow Direction



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.
- The 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 3.5 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 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, 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 the 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 following conditions exist:

- 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°C ± 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 (such as intensity, wavelength, and forward voltage). Set the application current as close as possible to the test current to minimize these variations.
- White LEDs must not be exposed to acidic environments and must not be used in the vicinity of any compound that can have acidic outgas, such as, but not limited to, acrylate adhesive. These environments have an adverse effect on LED performance.
- This LED is designed to have enhanced gas corrosion resistance. Its performance has been tested according to these conditions:
 - IEC 60068-2-42: 25°C/75% RH, SO₂ 25 ppm, 21 days.
 - IEC 60068-2-60: 25°C/75% RH, SO₂ 200 ppb, NO₂ 200 ppb, H₂S 10 ppb, Cl₂ 10 ppb, 21 days.

As 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 change in ambient temperatures, especially in high-humidity environments, because they cause condensation on the LED.
- If the LED is intended to be used in a harsh or an outdoor environment, protect the LED against damages caused by rain water, 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:

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

where:

T_A = Ambient temperature ($^{\circ}\text{C}$)

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

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:

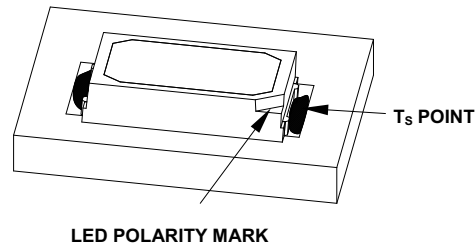
T_S = LED solder point temperature as shown in the following figure ($^{\circ}\text{C}$)

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

I_F = Forward current (A)

V_{Fmax} = Maximum forward voltage (V)

Figure 23: 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 $R_{\theta J-S}$ 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 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.

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