Data Sheet

ASCKCx00-xxxxxxxxxxx

1608 DFN-2 Surface-Mount LED

Overview

The Broadcom® ASCKCx00 surface-mount LEDs utilize AlInGaP and InGaN chips in a small-form-factor DFN-2 package. The LEDs are designed with high-reliability performance to work under a wide range of environmental conditions. The small-form-factor package also enables flexibility in product design and is ideal for a wide range of applications.

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

Features

- High reliability package with enhanced silicone resin encapsulation
- Wide viewing angle at 120°
- Small package form factor and thickness for better design flexibility
- Available in yellow green, amber, red, super red, blue, and green
- JEDEC MSL 3

Applications

- Status indicators
- Indoor info signs and displays
- Wearables and portable devices
- Office automation, home appliances, industrial equipment
  - Front-panel backlighting
  - Push-button backlighting
  - Display backlighting
  - Keypad backlighting
  - Symbol backlighting

CAUTION! This LED is ESD sensitive. Please observe appropriate precautions during handling and processing. Refer to Application Note 1142 for additional detail.

Figure 1: Package Drawing for InGaN Blue and Green

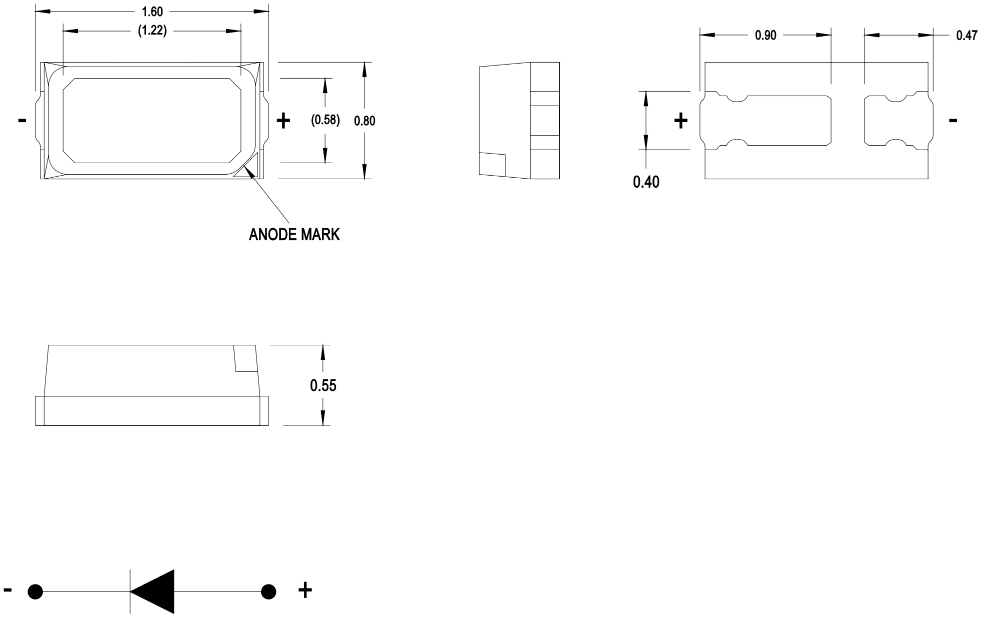
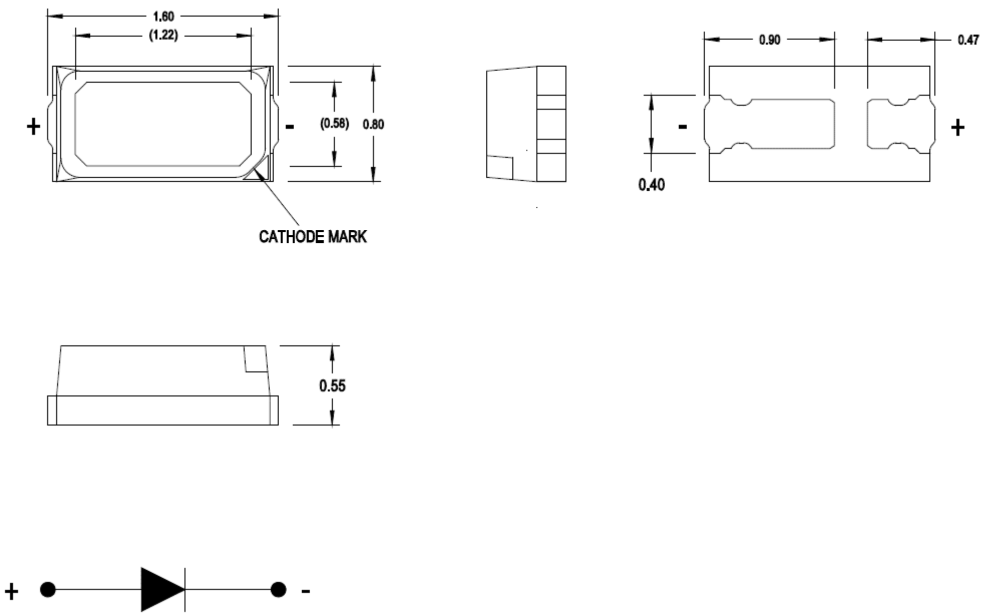


Figure 2: Package Drawing for AlInGaP Yellow Green, Amber, Red, and Super Red



NOTE:

- All dimensions are in millimeters (mm).
- Tolerance is ±0.20 mm unless otherwise specified.
- Encapsulation = silicone.
- Terminal finish = silver plating.
- Dimensions in parentheses are for reference only.

Device Selection Guide (T_J = 25°C)

Part Number	Color	Die Type	Luminous Intensity, I_V (mcd) [a, b]			Test Current, I_F (mA)
			Min.	Typ.	Max.	
ASCKCF00-AP5R5010402	Yellow Green	AlInGaP	61.3	—	180	20
ASCKCA00-AS3S5020502	Amber	AlInGaP	180	—	285	20
ASCKCR00-AQ3R4030402	Red	AlInGaP	71.5	—	154	20
ASCKCS00-AQ5R5050702	Super Red	AlInGaP	96.7	—	180	20
ASCKCB00-NS3T4010302	Blue	InGaN	180	—	386	20
ASCKCG00-NU3V3020301	Green	InGaN	450	—	832	10

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. Tolerance is ±12%.

Absolute Maximum Ratings

Parameters	AlInGaP	InGaN	Unit
DC Forward Current [a]	30	25	mA
Peak Forward Current [b]	100	100	mA
Power Dissipation	72	90	mW
Reverse Voltage	Not designed for reverse bias operation		
LED Junction Temperature	110	110	°C
Operating Temperature Range	–40 to +100	–40 to +100	°C
Storage Temperature Range	–40 to +100	–40 to +100	°C

a. Derate linearly as shown in Figure 16 and Figure 17.

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

Optical and Electrical Characteristics (T_J = 25°C)

Test current, I_F: Green = 10 mA; Yellow Green, Amber, Red, Super Red, and Blue = 20 mA.

Parameters	Min.	Typ.	Max.	Unit
Viewing Angle, $2\theta_{½}$ [a]	—	120	—	°
Forward Voltage, V_F [b]				
Yellow Green, Amber, Red, Super Red	1.8	2.0	2.4	V
Blue	2.6	3.1	3.6	
Green	2.6	3.0	3.6	
Reverse Current, I_R, at V_R = 5V [c]	—	—	10	µA
Dominant Wavelength, λ_d [d]				
Yellow Green	564.5	572	576.5	nm
Amber	583	589	595	
Red	615	626	630	
Super Red	627	631	637	
Blue	460	467	475	
Green	520	527	530	
Peak Wavelength, λ_p				
Yellow Green	—	573	—	nm
Amber	—	592	—	
Red	—	637	—	
Super Red	—	643	—	
Blue	—	462	—	
Green	—	520	—	
Thermal Resistance, $R_{\theta J\text{-}S}$ [e]				
Yellow Green	—	260	—	°C/W
Amber	—	220	—	
Red	—	300	—	
Super Red	—	300	—	
Blue	—	200	—	
Green	—	240	—	

a. θ½ is the off-axis angle where the luminous intensity is half of the peak intensity.

b. Forward voltage tolerance is ±0.1V.

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

d. The dominant wavelength is derived from the CIE Chromaticity diagram and represents the perceived color of the device.

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

Part Numbering System

A S C K C x_1 0 0 – x_2 x_3 x_4 x_5 x_6 0 x_7 0 x_8 0 x_9

Code	Description	Option	
x_1	Color	A	Amber
		B	Blue
		F	Yellow Green
		G	Green
		R	Red
		S	Super Red
x_2	Die Type	A	AlInGaP
		N	InGaN
x_3 x_4	Minimum Intensity Bin	See the Intensity Bin Limits (CAT) table.	
x_5 x_6	Maximum Intensity Bin		
x_7	Minimum Color Bin	See the Color Bin Limits (BIN) table.	
x_8	Maximum Color Bin		
x_9	Test Current	1	10 mA
		2	20 mA

Part Number Example

ASCKCB00-NS3T4010302

x_1 : B – Blue

x_2 : N – InGaN

x_3 x_4 : S3 – Minimum intensity bin S3

x_5 x_6 : T4 – Maximum intensity bin T4

x_7 : 1 – Minimum color bin 1

x_8 : 3 – Maximum color bin 3

x_9 : 2 – Test current = 20 mA

Bin Information

Intensity Bin Limits (CAT)

Bin ID	Luminous Intensity, I_V (mcd)	
	Min.	**Max.**
P5	61.3	71.5
Q3	71.5	83.2
Q4	83.2	96.7
Q5	96.7	112.5
R3	112.5	132
R4	132	154
R5	154	180
S3	180	210
S4	210	245
S5	245	285
T3	285	332
T4	332	386
T5	386	450
U3	450	525
U4	525	613
U5	613	715
V3	715	832
V4	832	967
V5	967	1125
W3	1125	1320
W4	1320	1540
W5	1540	1800
X3	1800	2100
X4	2100	2450
X5	2450	2850

Tolerance = ±12%

Forward Voltage Bin Limits (V_F)

Bin ID	Forward Voltage, V_F (V)	
	Min.	**Max.**
F00	1.8	2.0
F01	2.0	2.2
F02	2.2	2.4
F03	2.4	2.6
F04	2.6	2.8
F05	2.8	3.0
F06	3.0	3.2
F07	3.2	3.4
F08	3.4	3.6

Tolerance = ±0.1V

Color Bin Limits (BIN)

Yellow-Green

Bin ID	Dominant Wavelength, λ_d (nm)	
	Min.	Max.
1	564.5	567.5
2	567.5	570.5
3	570.5	573.5
4	573.5	576.5

Super Red

Bin ID	Dominant Wavelength, λ_d (nm)	
	Min.	Max.
5	627.0	630.0
6	630.0	634.0
7	634.0	637.0

Amber

Bin ID	Dominant Wavelength, λ_d (nm)	
	Min.	Max.
2	583.0	586.0
3	586.0	589.0
4	589.0	592.0
5	592.0	595.0

Blue

Bin ID	Dominant Wavelength, λ_d (nm)	
	Min.	Max.
1	460.0	465.0
2	465.0	470.0
3	470.0	475.0

Red

Bin ID	Dominant Wavelength, λ_d (nm)	
	Min.	Max.
2	615.0	620.0
3	620.0	625.0
4	625.0	630.0

Green

Bin ID	Dominant Wavelength, λ_d (nm)	
	Min.	Max.
2	520.0	525.0
3	525.0	530.0

Tolerance = ± 1.0nm

Example of bin information on a reel and packaging label:

CAT : S4 – Intensity bin S4

BIN : 3 – Color bin 3

V_F : F01 – V_F bin F01

Figure 3: Spectral Power Distribution

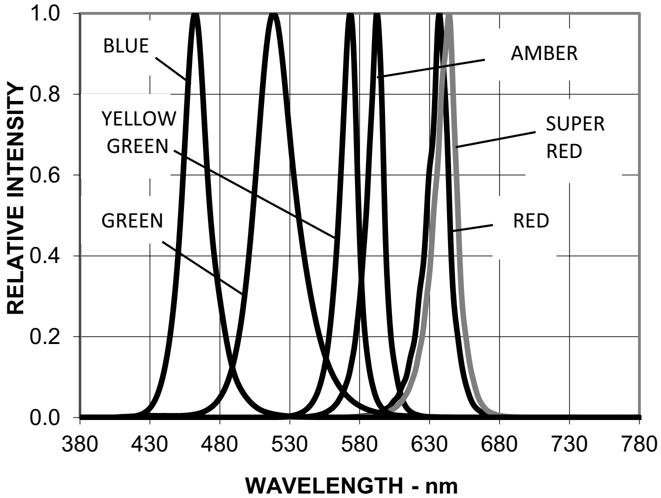


Figure 4: Forward Current vs. Forward Voltage

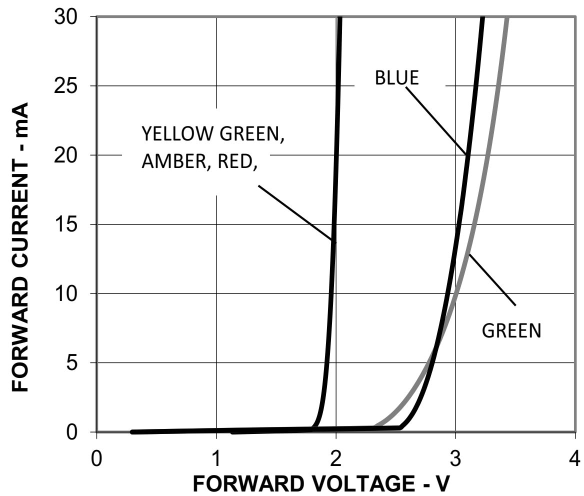


Figure 5: Relative Luminous Intensity vs. Mono Pulse Current (AlInGaP)

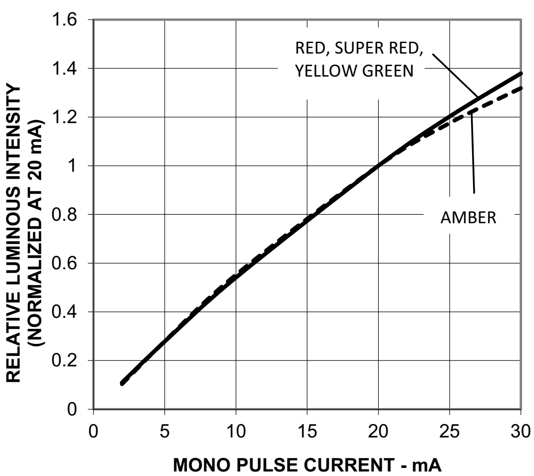


Figure 6: Relative Luminous Intensity vs. Mono Pulse Current (InGaN)

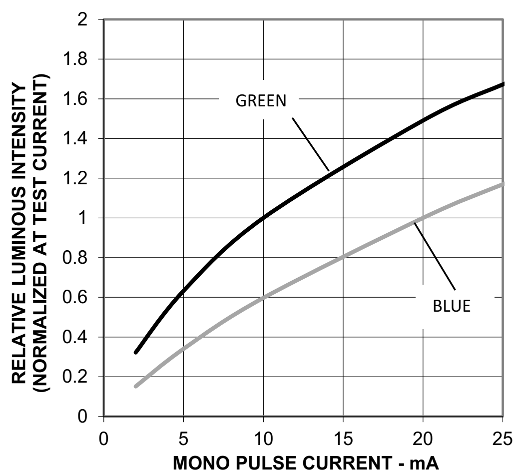


Figure 7: Radiation Pattern

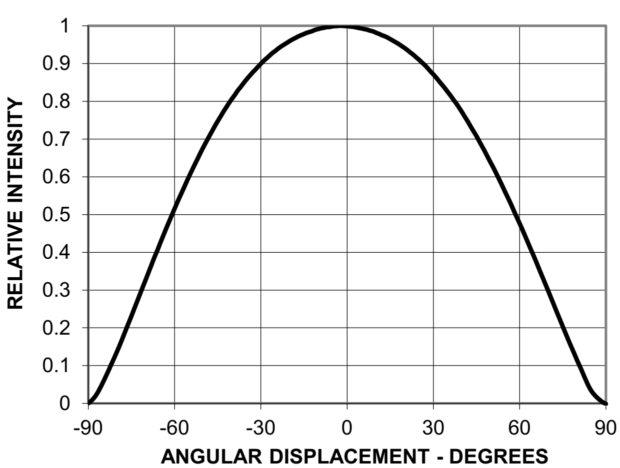


Figure 8: Dominant Wavelength Shift vs. Mono Pulse Current (AlInGaP)

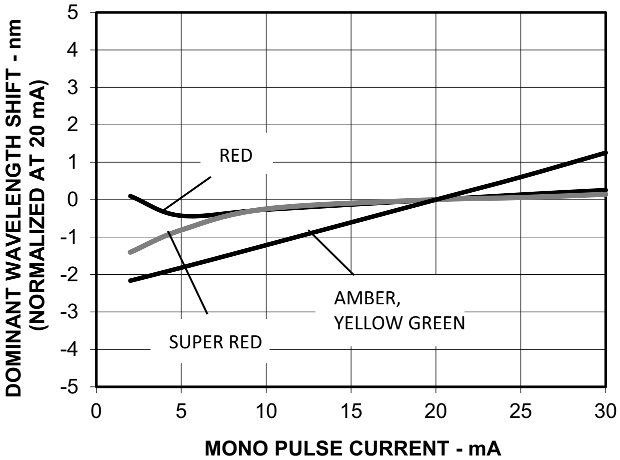


Figure 9: Dominant Wavelength Shift vs. Mono Pulse Current (InGaN)

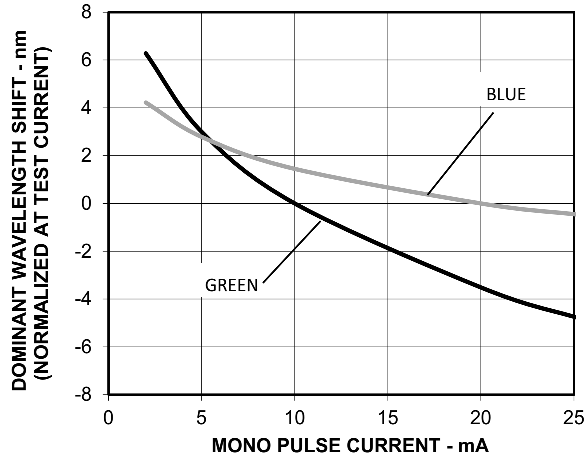


Figure 10: Forward Voltage Shift vs. Junction Temperature (AlInGaP)

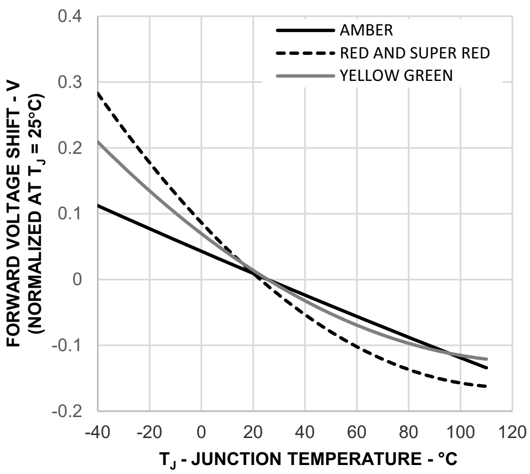


Figure 11: Forward Voltage Shift vs. Junction Temperature (InGaN)

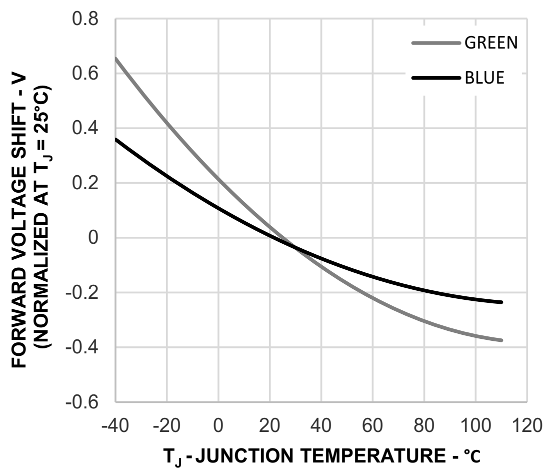


Figure 12: Relative Luminous Intensity vs. Junction Temperature (AlInGaP)

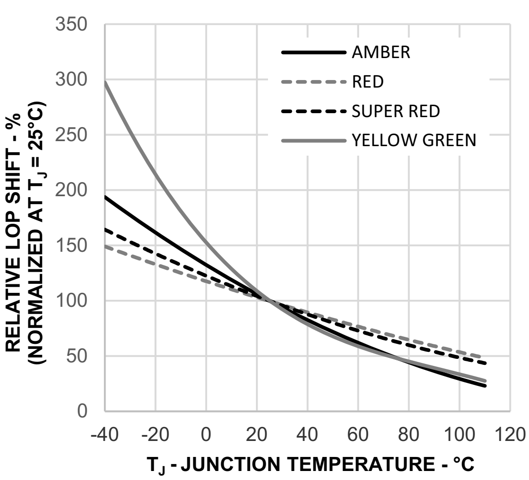


Figure 13: Relative Luminous Intensity vs. Junction Temperature (InGaN)

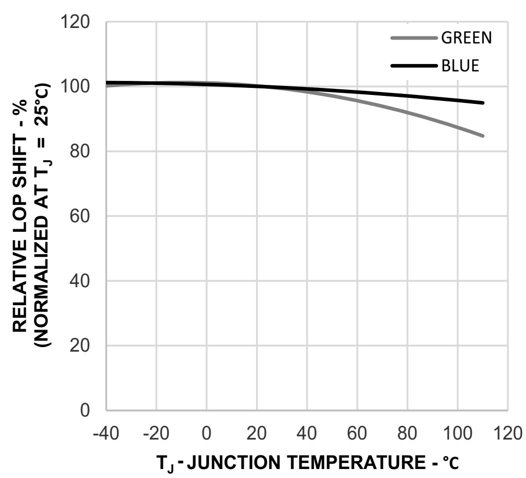


Figure 14: Dominant Wavelength Shift vs. Junction Temperature (AlInGaP)

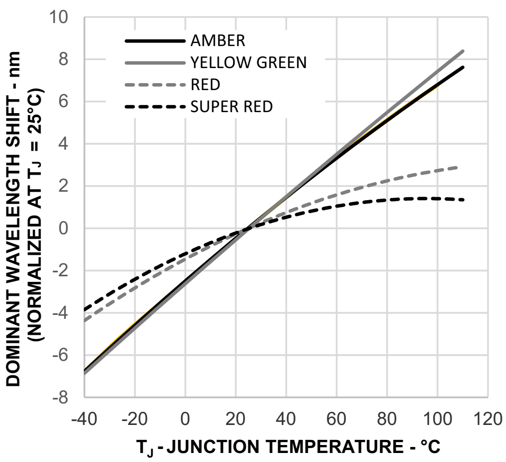


Figure 15: Dominant Wavelength Shift vs. Junction Temperature (InGaN)

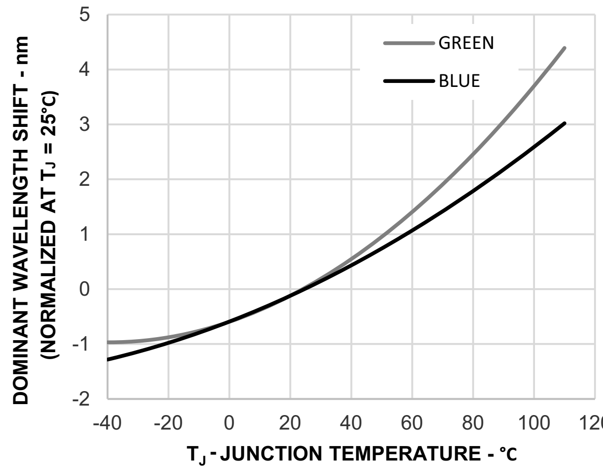


Figure 16: Maximum Forward Current vs. Ambient Temperature. Derated Based on T_{JMAX} = 110°C (AlInGaP)

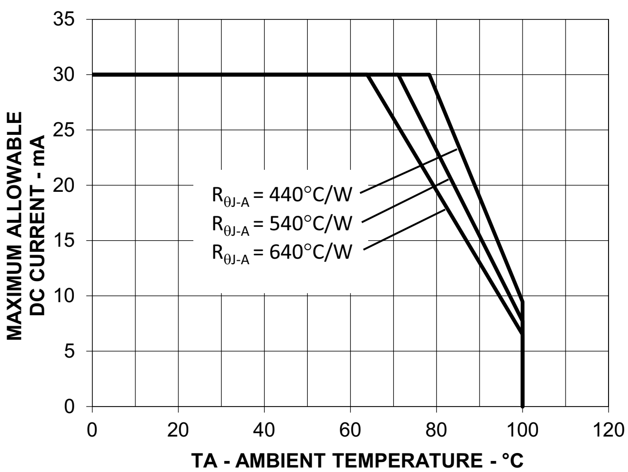


Figure 17: Maximum Forward Current vs. Ambient Temperature. Derated Based on T_{JMAX} = 110°C (InGaN)

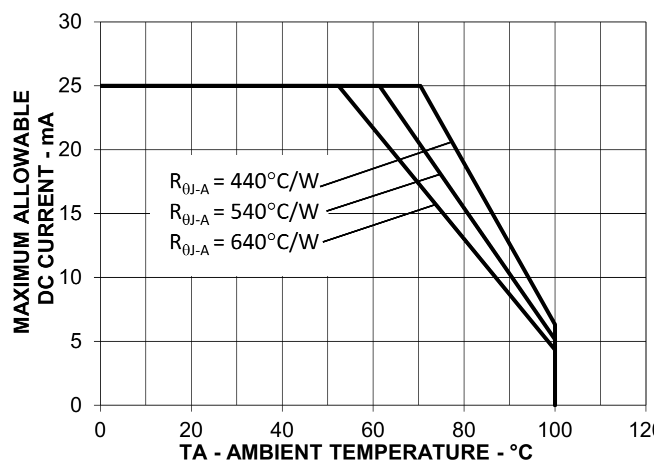


Figure 18: Maximum Forward Current vs. Solder Point Temperature. Derated Based on T_{JMAX} = 110°C (AlInGaP)

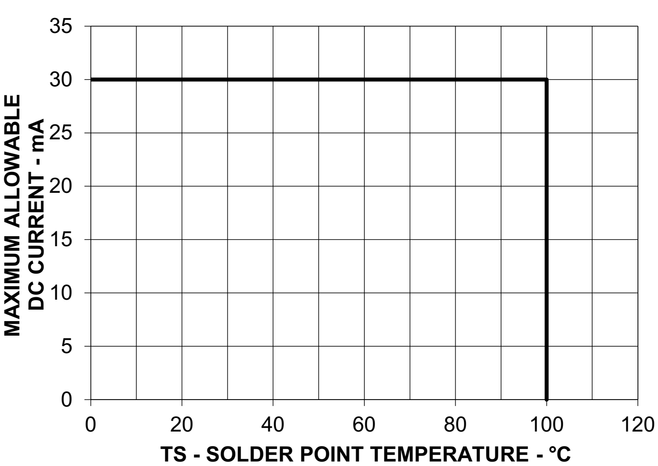


Figure 19: Maximum Forward Current vs. Solder Point Temperature. Derated Based on T_{JMAX} = 110°C (InGaN)

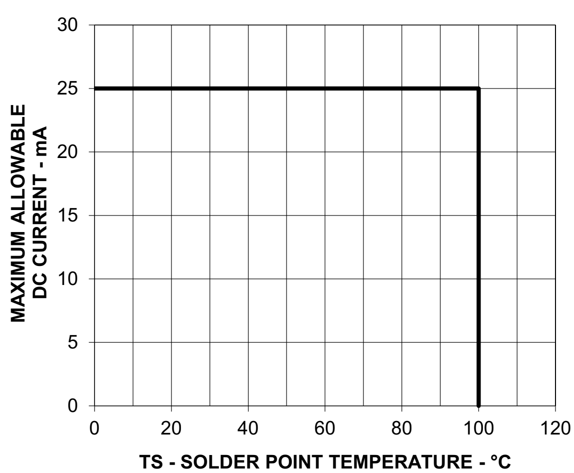
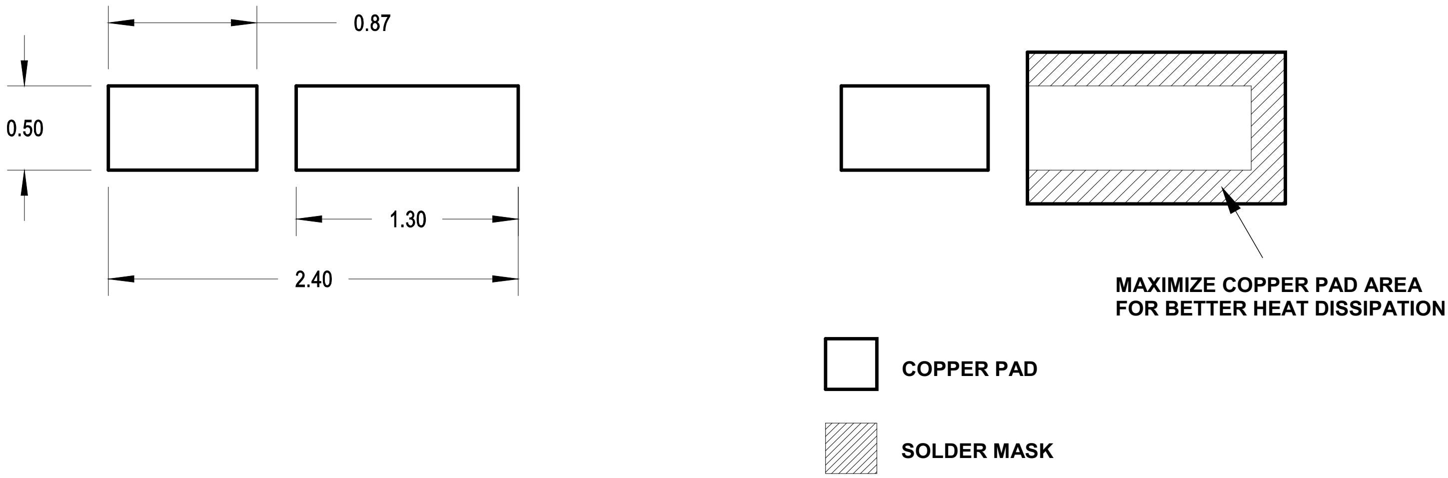
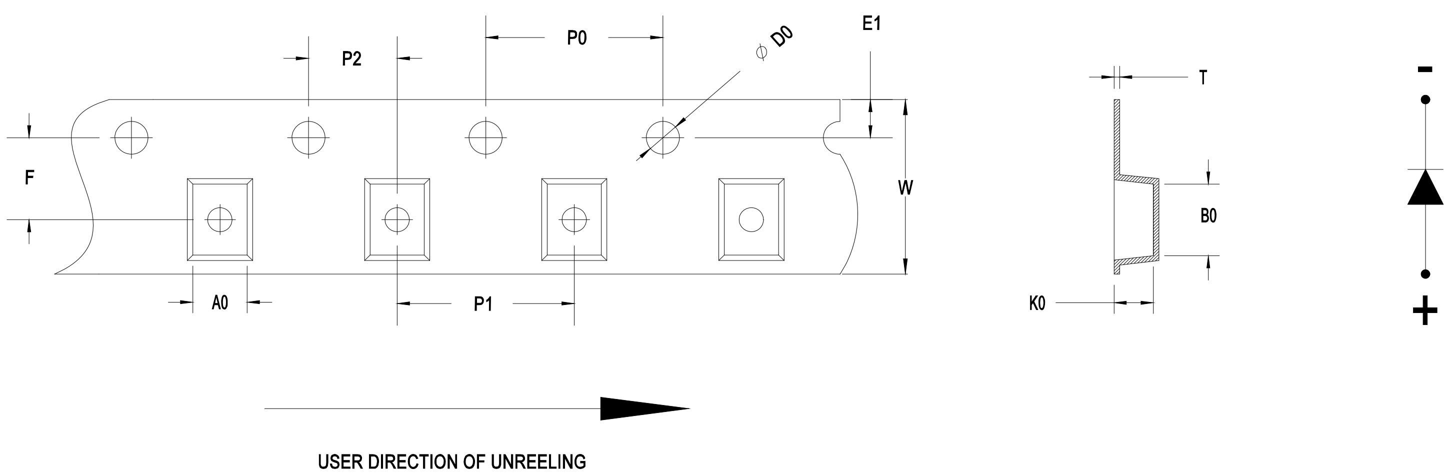


Figure 20: Recommended Soldering Land Pattern



NOTE: All dimensions are in millimeters (mm).

Figure 21: Carrier Tape Dimensions



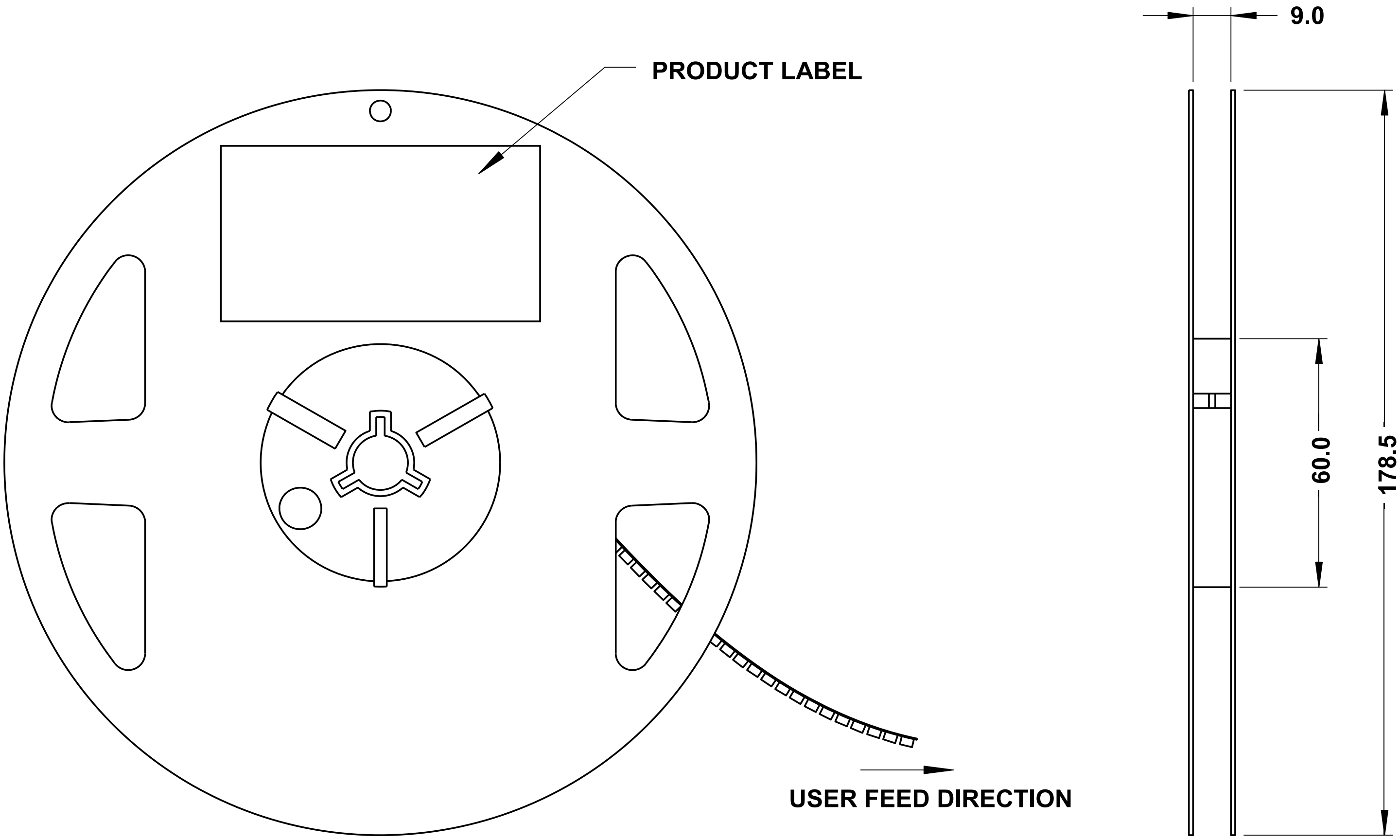
F	P0	P1	P2	D0	E1	W
3.5±0.05	4.0±0.1	4.0±0.1	2.0±0.05	1.55±0.05	1.75±0.1	8.0±0.3

T	B0	K0	A0
0.2±0.05	1.75±0.1	0.68±0.1	0.9±0.1

NOTE:

- All dimensions in millimeters (mm).
- Quantity per reel: 4000 pcs.

Figure 22: Reel Dimensions



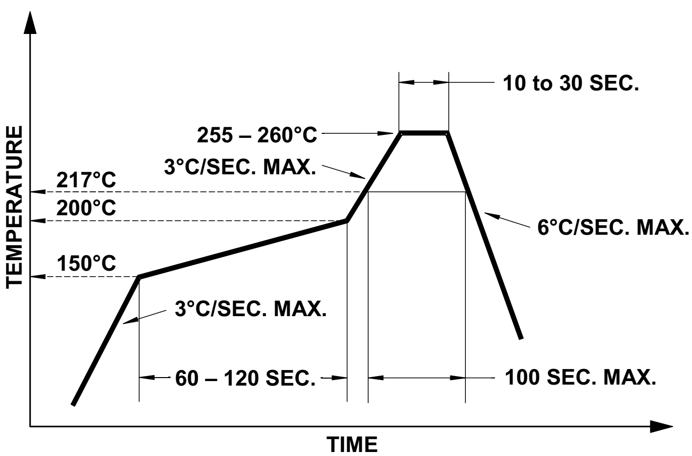
NOTE: All dimensions are in millimeters (mm).

Precautionary Notes

Soldering

- Do not perform reflow soldering more than twice. Observe necessary precautions of handling moisture-sensitive 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 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, as it may cause damage to the LED.
- Confirm beforehand whether the functionality and performance of the LED are affected by soldering with hand soldering.

Figure 23: Recommended Lead-Free Reflow Soldering Profile



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. For additional information, refer to Broadcom Application Note 5288, *Silicone Encapsulation for LED: Advantages and Handling Precautions*.

- 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.

Handling of Moisture-Sensitive Devices

This product has a Moisture Sensitive Level 3 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°/60%RH at all times, and complete all high-temperature-related processes, including soldering, curing, or rework within 168 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 a desiccator at <5% RH to ensure that all LEDs have not exceeded their floor life of 168 hours.
- Baking is required if:
  - 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 168 hours.

  The recommended baking condition is 60±5ºC for 20 hours.

  Baking can be done only 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 this 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 that 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.
- The LED is not intended for reverse bias. Use other appropriate components for such purposes.
- 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 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 a 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:

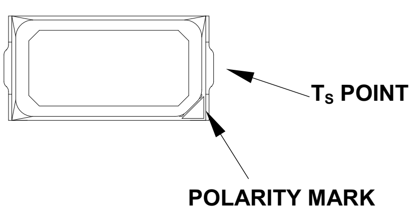
T_S = LED solder point temperature as shown in the following figure (°C)

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

I_F = Forward current (A)

V_{Fmax} = Maximum forward voltage (V)

Figure 24: Solder Point Temperature on PCB



T_S can be easily measured by mounting a thermocouple on the soldering joint as shown in the 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 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.

Disclaimer

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RoHS Compliant