Data Sheet

ASM6-Sxxx-xxxxH

3W 3535 Surface Mount LED

Description

The Broadcom® ASM6 LED series, a proliferation from the earlier ASM3 series, are the latest high power LEDs development edition. While maintaining similar 3535 footprint, the ASM6 series exhibit higher lumen output and display better cost per lumen ratio. This new ASM6 family is energy efficient and adapts good heat sink properties. It is also superior in package robustness and better product longevity with its silicone encapsulation.

Features

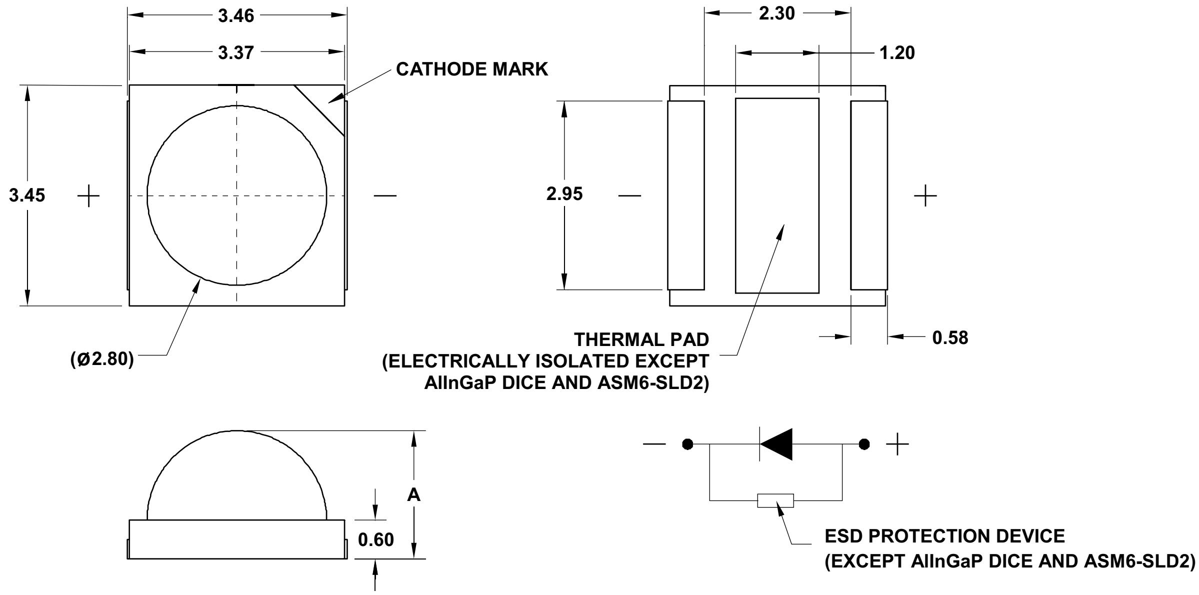
- High reliability package with enhanced silicone resin encapsulation
- Available in Far Red, Deep Red, Red, Royal Blue, and Green
- Available in 90° and 130° viewing angles
- Compatible with reflow soldering process
- JEDEC MSL 1

Applications

- Horticulture lighting
- Commercial lighting
- Architecture lighting
- Specialty 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



Part Number	Dimension A (mm)
ASM6-SxDx-xxxxH	1.90
ASM6-Sx9x-xxxxH	2.50

NOTE:

1. All dimensions are in millimeters (mm).
2. Tolerance is ± 0.20 mm unless otherwise specified.
3. Thermal pad is connected to anode for AlInGaP dice and ASM6-SLD2.
4. Encapsulation = silicone.
5. Terminal finish = silver plating.
6. Dimensions in parentheses are for reference only.

Device Selection Guide (T_J = 25°C, I_F = 350 mA)

Part Number	Color	Viewing Angle, $2\theta_{½}$ (°)[a]	Radiant Flux, Φ_e (mW)[b, c]			PPF, Φ_P (µmol/s)[d, e]	PPF/W (µmol/J)	Dice Technology
		Typ.	Min.	Typ.	Max.	Typ.	Typ.	
ASM6-S390-ANQ0H	Far Red	90	330	350	480	2.11[f]	2.87	AlInGaP
ASM6-SD90-AQR0H	Deep Red	90	430	450	530	2.44	3.32	AlInGaP
ASM6-SL91-NST0H	Royal Blue	90	530	580	705	2.18	2.15	InGaN
ASM6-SL92-NTV0H	Royal Blue	90	610	730	930	2.76	2.72	InGaN
ASM6-S3D0-ANQ0H	Far Red	130	330	350	480	2.11[f]	2.87	AlInGaP
ASM6-SDD0-AQR0H	Deep Red	130	430	450	530	2.44	3.32	AlInGaP
ASM6-SLD1-NST0H	Royal Blue	130	530	580	705	2.18	2.15	InGaN
ASM6-SLD2-NTV0H	Royal Blue	130	610	730	930	2.76	2.72	InGaN

Part Number	Color	Viewing Angle, $2\theta_{½}$ (°)[a]	Luminous Flux, Φ_V (lm) [b, c]			PPF, Φ_P (µmol/s) [d, e]	PPF/W (µmol/J)	Dice Technology
		Typ.	Min.	Typ.	Max.	Typ.	Typ.	
ASM6-SR90-AHK0H	Red	90	50	62	78	1.45	1.88	AlInGaP
ASM6-SG91-NQT0H	Green	90	127	145	186	1.32	1.30	InGaN
ASM6-SRD0-AHK0H	Red	130	50	62	78	1.45	1.88	AlInGaP
ASM6-SGD1-NRT0H	Green	130	140	145	186	1.32	1.30	InGaN

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

b. Radiant flux, Φ_e/Luminous flux, Φ_V is the total output measured with an integrating sphere at a single current pulse condition.

c. Radiant flux, Φ_e /Luminous flux, Φ_V tolerance is ± 10%.

d. Photosynthetic Photon Flux (PPF), Φ_P, is the measurement of Photosynthetically Active Radiation (PAR) ranging from 400 nm to 700 nm.

e. Values are calculated and for reference only.

f. Plant Biologically Active Radiation Flux (PBAR) for Far Red is measured from 280 nm to 800 nm.

Absolute Maximum Ratings

Parameters	Royal Blue and Green	Deep Red and Far Red	Red	Units
DC Forward Current[a]	1000	1000	700	mA
Peak Forward Current[b]	2000	2000	2000	mA
Power Dissipation	3400	2600	1960	mW
Reverse Voltage	Not designed for reverse bias operation			
LED Junction Temperature	125			°C
Operating Temperature Range	–40 to +120	–40 to +120	–40 to +120	°C
Storage Temperature Range	–40 to +120	–40 to +120	–40 to +120	°C

a. Derate linearly as shown in Figures 19, 20, 21, 22, 23, and 24.

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

Optical and Electrical Characteristics (T_J = 25°C, I_F = 350 mA)

Color	Peak Wavelength, λ_p (nm)			Forward Voltage, V_F (V)[a]			Thermal Resistance, $R_{\theta J-S}$ (°C/W)[b]
	Min.	Typ.	Max.	Min.	Typ.	Max.	Typ.
Far Red	720	735	745	1.8	2.1	2.6	3
Deep Red	650	655	670	1.8	2.1	2.6	3
Royal Blue	440	450	460	2.6	2.9	3.4	3

Color	Dominant Wavelength, λ_d (nm)			Forward Voltage, V_F (V)[a]			Thermal Resistance, $R_{\theta J-S}$ (°C/W)[b]
	Min.	Typ.	Max.	Min.	Typ.	Max.	Typ.
Red	617	625	635	1.8	2.2	2.8	4
Green	515	525	535	2.6	2.9	3.4	6

a. Forward voltage, V_F, tolerance is ± 0.1V.

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

Performance Characteristics (T_J = 25°C, I_F = 700 mA)

Part Number	Color	Viewing Angle, $2\theta_{½}$ (°)	Radiant Flux, Φ_e (mW)	PPF, Φ_P (µmol/s)	Forward Voltage, V_F (V)
		Typ.	Typ.	Typ.	Typ.
ASM6-S390-ANQ0H	Far Red	90	662	3.99	2.5
ASM6-SD90-AQR0H	Deep Red	90	851	4.61	2.5
ASM6-SL91-NST0H	Royal Blue	90	1096	4.12	3.3
ASM6-SL92-NTV0H	Royal Blue	90	1380	5.22	3.2
ASM6-S3D0-ANQ0H	Far Red	130	662	3.99	2.5
ASM6-SDD0-AQR0H	Deep Red	130	851	4.61	2.5
ASM6-SLD1-NST0H	Royal Blue	130	1096	4.12	3.3
ASM6-SLD2-NTV0H	Royal Blue	130	1380	5.22	3.2

Part Number	Color	Viewing Angle, $2\theta_{½}$ (°)	Luminous Flux, Φ_v (lm)	PPF, Φ_P (µmol/s)	Forward Voltage, V_F (V)
		Typ.	Typ.	Typ.	Typ.
ASM6-SR90-AHK0H	Red	90	111	2.60	2.4
ASM6-SG91-NQT0H	Green	90	231	2.10	3.4
ASM6-SRD0-AHK0H	Red	130	111	2.60	2.4
ASM6-SGD1-NRT0H	Green	130	231	2.10	3.4

Part Numbering System

A	S	M	6	-	S	x_1	x_2	x_3	-	x_4	x_5	x_6	x_7	x_8

Code	Description	Option	
x_1	Color	3	Far Red
		D	Deep Red
		G	Green
		L	Royal Blue
		R	Red
x_2	Viewing Angle	D	130°
		9	90°
x_3	Internal Code		
x_4	Dice Technology	A	AlInGaP
		N	InGaN
x_5	Minimum Flux Bin	Refer to Radiant Flux / Luminous Flux Bin Limits (CAT) table	
x_6	Maximum Flux Bin		
x_7	Color Bin Option	0	Full Distribution
x_8	Test Option	H	Test Current = 350 mA

Part Number Example

ASM6-S3D0-ANQ0H

x_1: 3 – Far Red color

x_2: D – 130° viewing angle

x_4: A – AlInGaP dice

x_5: N – Minimum radiant flux bin N

x_6: Q – Maximum radiant flux bin Q

x_7: 0 – Full color distribution

x_8: H – Test current = 350 mA

Bin Information

Luminous Flux Bin Limits (CAT)

Bin ID	Luminous Flux, Φ_V (lm)	
	Min.	Max.
Red and Green		
H	50.0	58.0
J	58.0	67.3
K	67.3	78.0
L	78.0	90.5
M	90.5	105.0
N	105.0	115.0
P	115.0	127.0
Q	127.0	140.0
R	140.0	154.0
S	154.0	169.0
T	169.0	186.0

Tolerance = ± 10%.

Radiant Flux Bin Limits (CAT)

Bin ID	Radiant Flux, Φ_e (mW)	
	Min.	Max.
Far Red, Deep Red, and Royal Blue		
N	330	380
P	380	430
Q	430	480
R	480	530
S	530	610
T	610	705
U	705	810
V	810	930

Tolerance = ± 10%.

Example of bin information on reel and packaging label:

CAT: P – Luminous / Radiant Flux bin P
BIN: — – Full distribution color bin
VF: — – Forward Voltage bin

Color Bin Limits (BIN)

Bin ID	Peak Wavelength, λ_p (nm)	
	Min.	Max.
Royal Blue		
3	440	445
4	445	450
5	450	455
6	455	460
Deep Red		
—	650	670
Far Red		
—	720	745

Bin ID	Dominant Wavelength, λ_d (nm)	
	Min.	Max.
Green		
1	515	520
2	520	525
3	525	530
4	530	535
Red		
—	617	635

Tolerance = ± 1.0 nm.

Forward Voltage Limits (V_F)

Bin ID	Forward Voltage, V_F (V)	
	Min.	Max.
1	1.8	2.0
2	2.0	2.2
3	2.2	2.4
4	2.4	2.6
5	2.6	2.8
6	2.8	3.0
7	3.0	3.2
8	3.2	3.4

Tolerance = ± 0.1V.

Figure 2: Spectral Power Distribution – Far Red, Deep Red, Red, Royal Blue, and Green

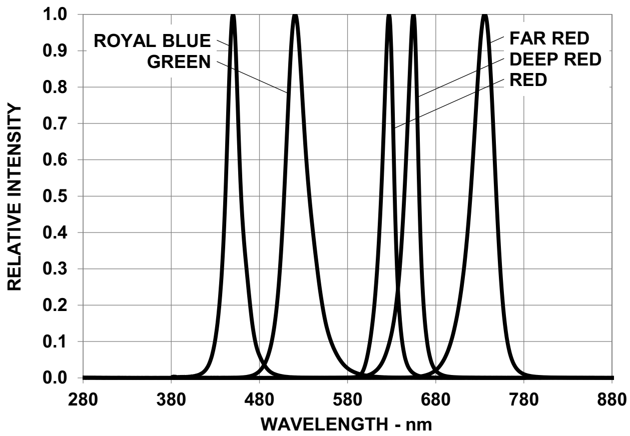


Figure 3: Forward Current vs. Forward Voltage – Royal Blue and Green

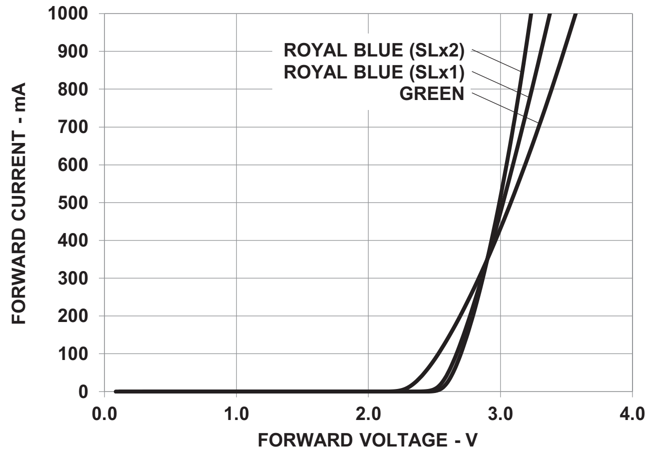


Figure 4: Forward Current vs. Forward Voltage – Far Red, Deep Red, and Red

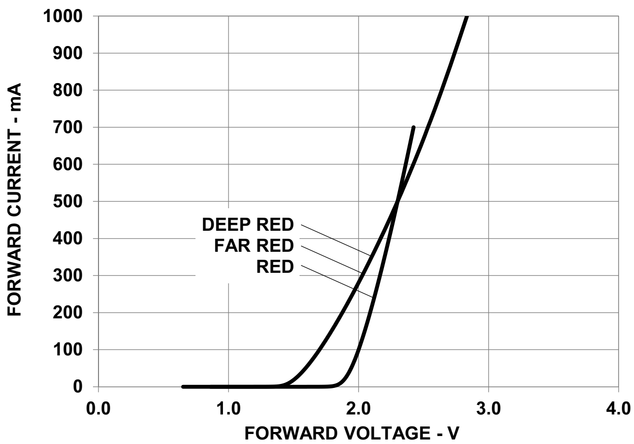


Figure 5: Relative Luminous Flux vs. Mono Pulse Current – Green

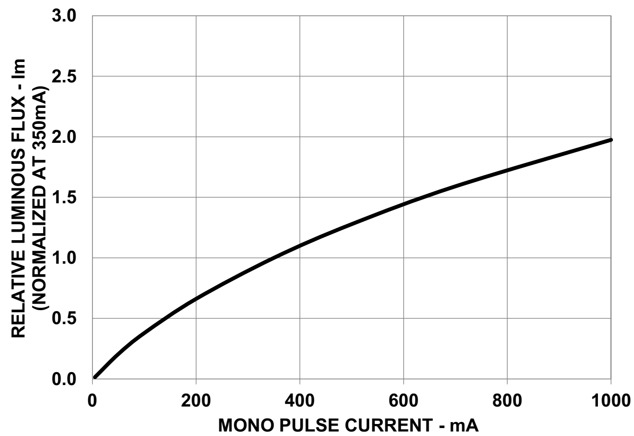


Figure 6: Relative Luminous Flux vs. Mono Pulse Current – Red

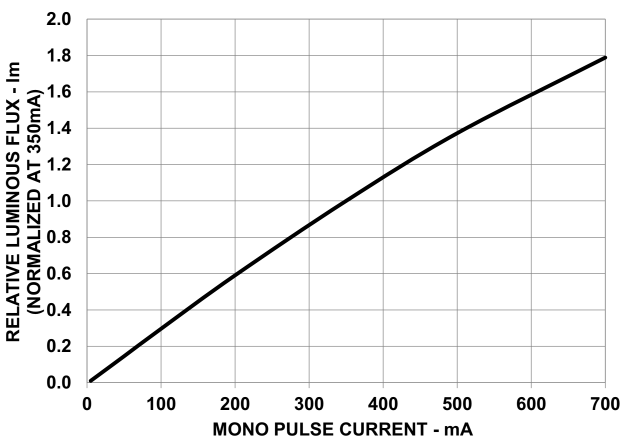


Figure 7: Relative Radiant Flux vs. Mono Pulse Current – Royal Blue, Far Red, and Deep Red

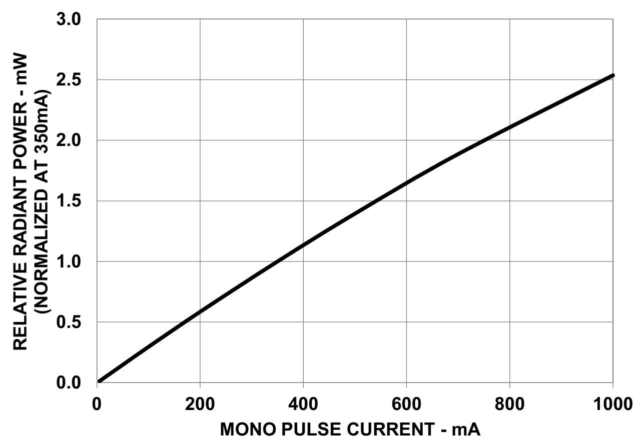


Figure 8: Dominant Wavelength Shift vs. Mono Pulse Current – Red and Green

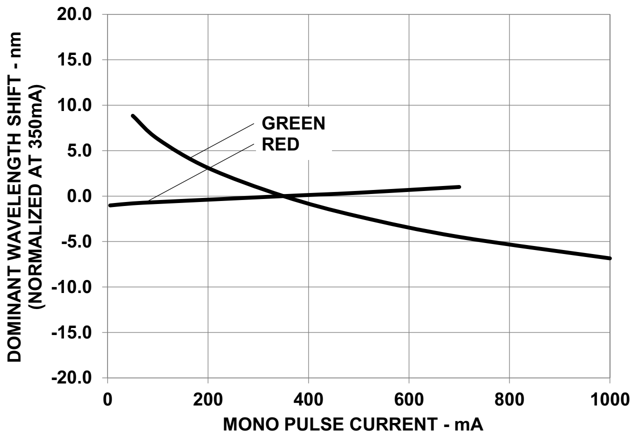


Figure 9: Peak Wavelength Shift vs. Mono Pulse Current – Far Red, Deep Red, and Royal Blue

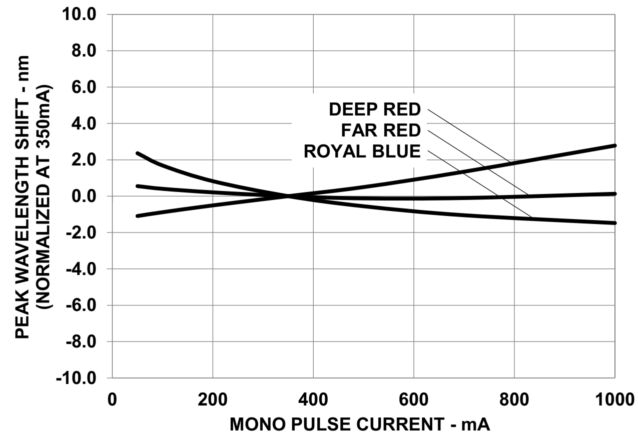


Figure 10: Relative Radiant Output vs. Junction Temperature – Royal Blue, Far Red, and Deep Red

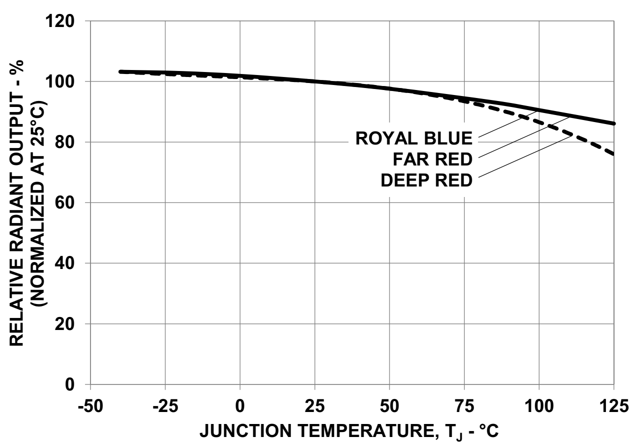


Figure 11: Relative Light Output vs. Junction Temperature – Red and Green

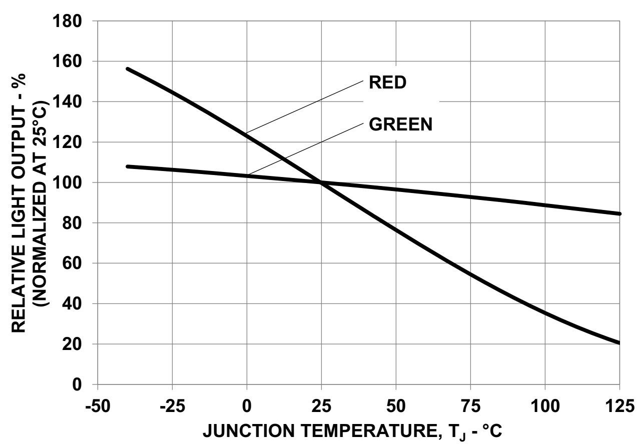


Figure 12: Forward Voltage Shift vs. Junction Temperature – Royal Blue and Green

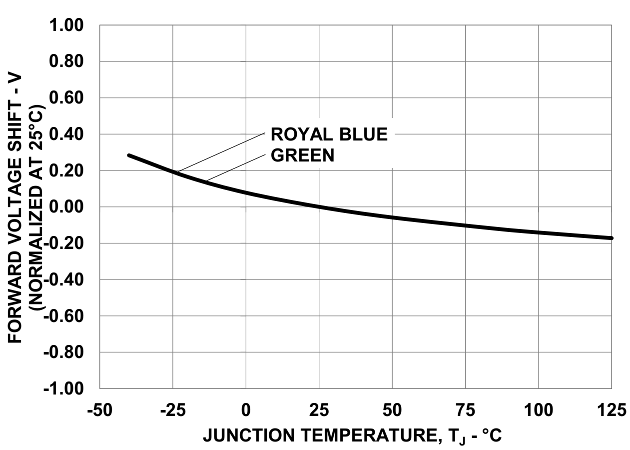


Figure 13: Forward Voltage Shift vs. Junction Temperature – Far Red, Deep Red, and Red

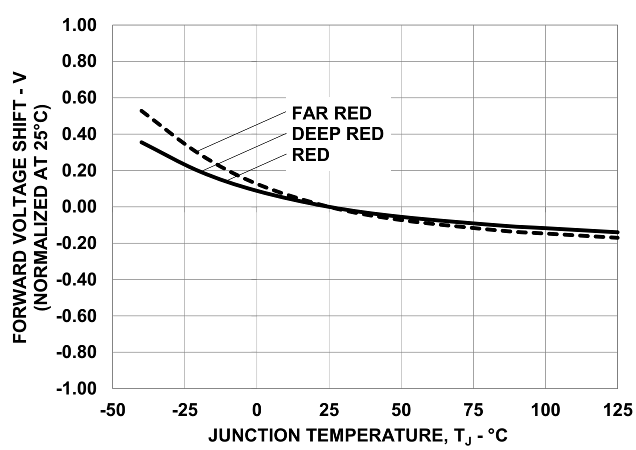


Figure 14: Dominant Wavelength Shift vs. Junction Temperature – Red and Green

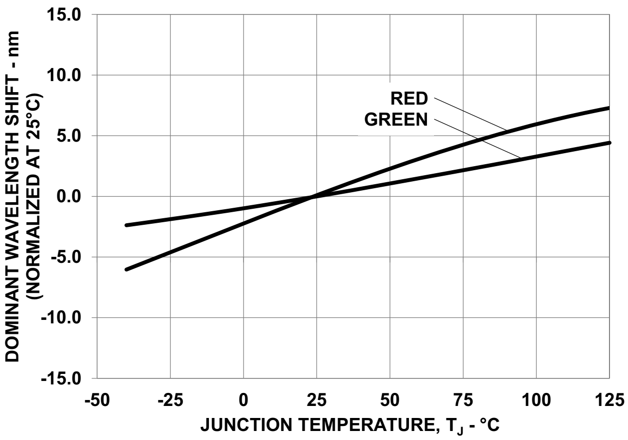


Figure 15: Peak Wavelength Shift vs. Junction Temperature – Far Red, Deep Red, and Royal Blue

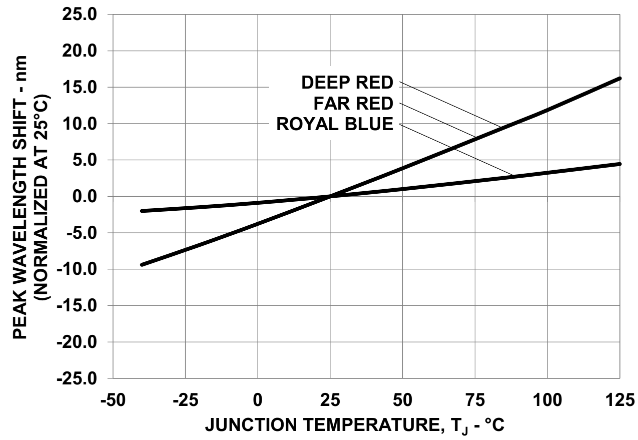


Figure 16: Radiation Pattern 130° – Royal Blue and Green

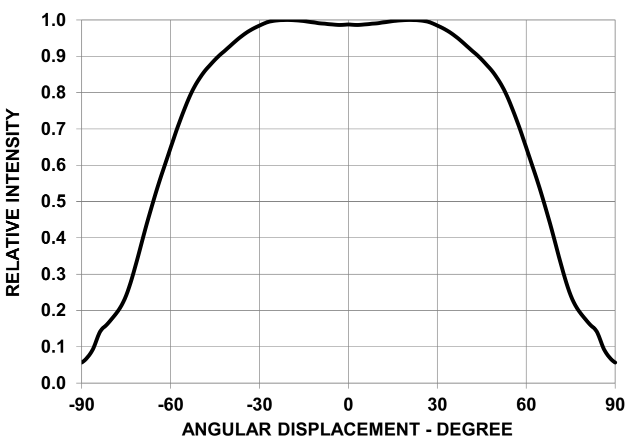


Figure 17: Radiation Pattern 130° – Far Red, Deep Red, and Red

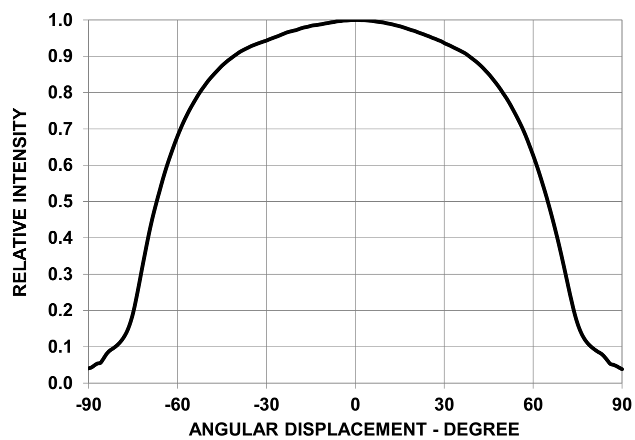


Figure 18: Radiation Pattern 90°

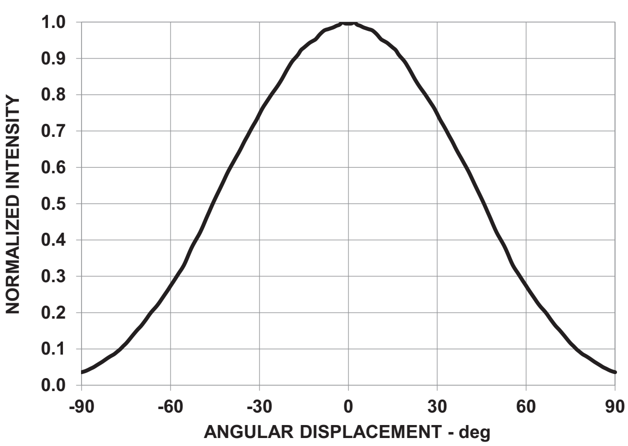


Figure 19: Maximum Forward Current vs. Ambient Temperature – Royal Blue and Green

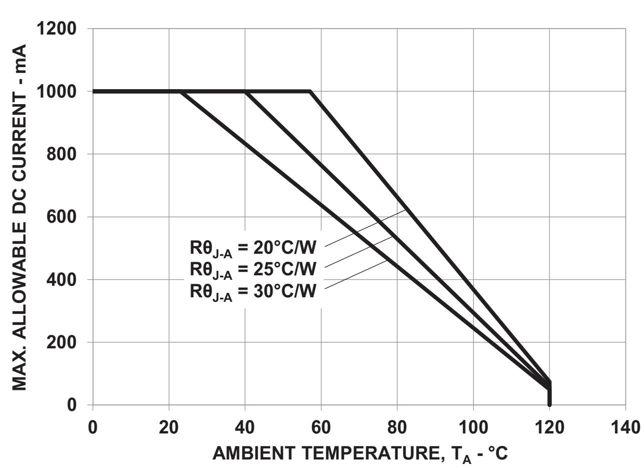


Figure 20: Maximum Forward Current vs. Ambient Temperature – Far Red and Deep Red

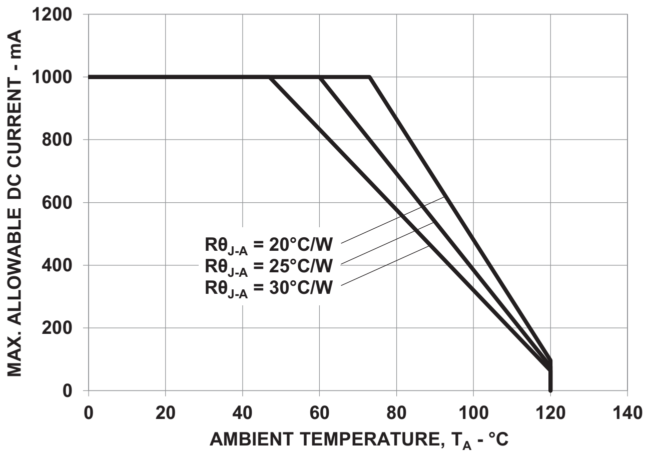


Figure 21: Maximum Forward Current vs. Ambient Temperature – Red

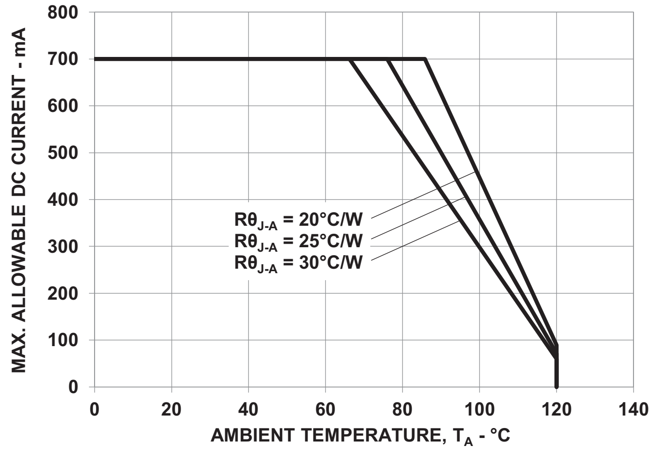


Figure 22: Maximum Forward Current vs. Solder Point Temperature – Royal Blue and Green

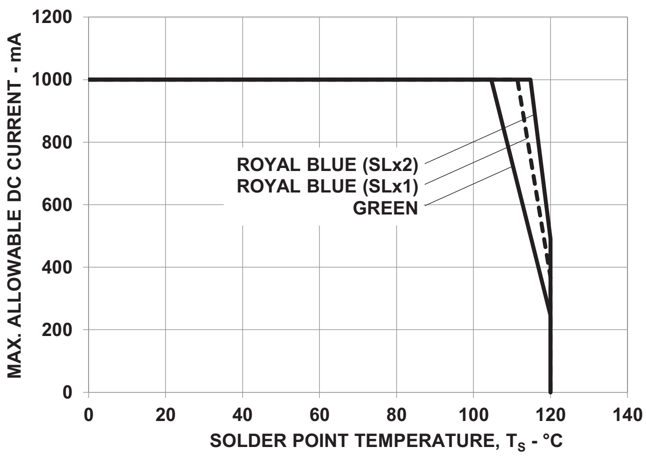


Figure 23: Maximum Forward Current vs. Solder Point Temperature – Far Red and Deep Red

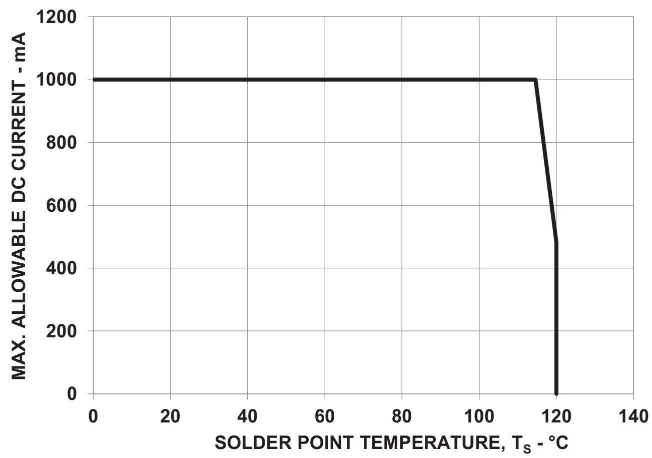


Figure 24: Maximum Forward Current vs. Solder Point Temperature – Red

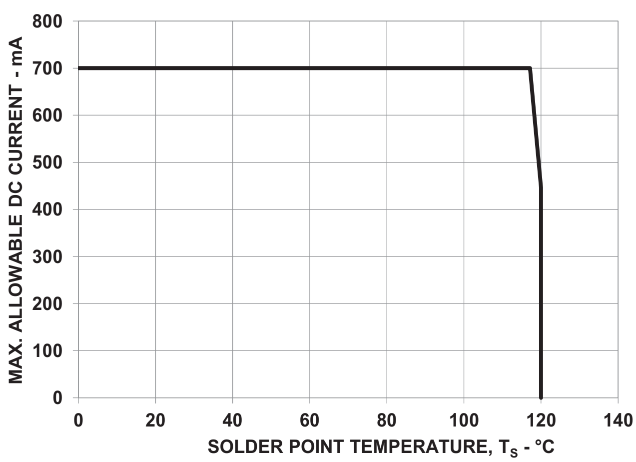


Figure 25: Recommended Soldering Land Pattern

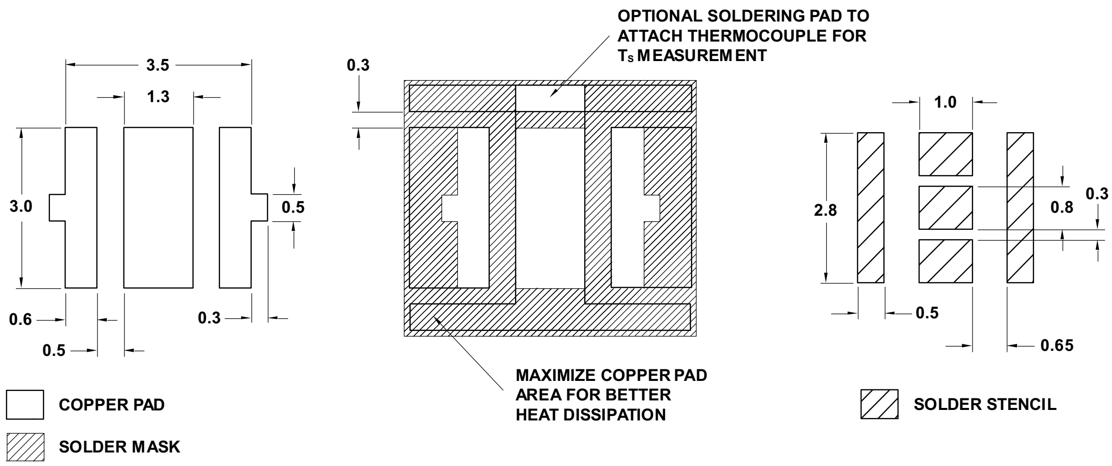
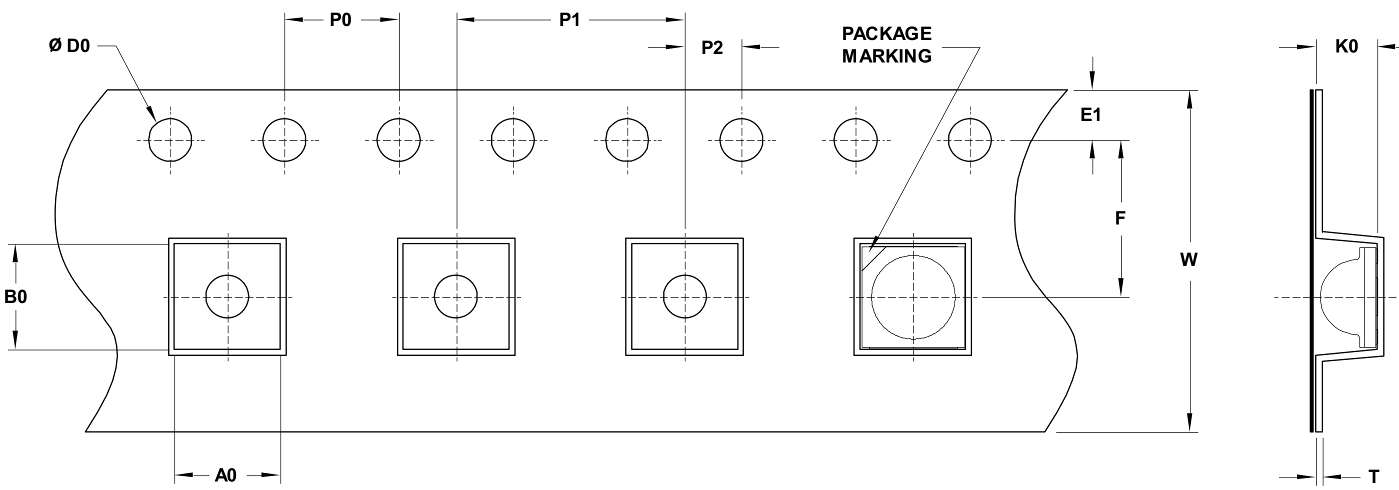


Figure 26: Carrier Tape Dimensions

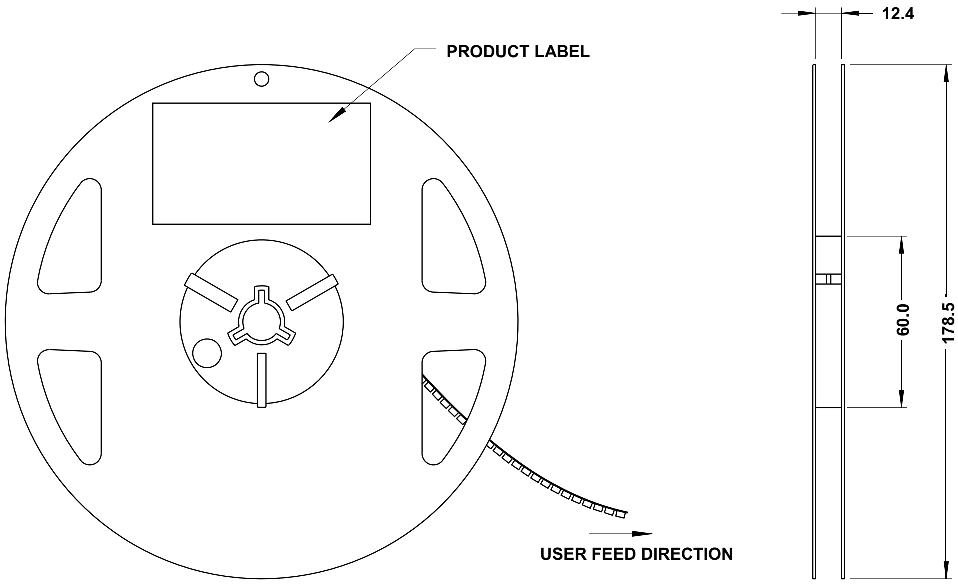


F	P0	P1	P2	D0	E1	W
5.50 ± 0.05	4.00 ± 0.10	8.00 ± 0.10	2.00 ± 0.05	1.50 ± 0.1	1.75 ± 0.10	12.00 ± 0.20

Part Number	T	A0	B0	K0
ASM6-SxDx	0.28 ±0.05	3.75 ± 0.10	3.75 ± 0.10	2.20 ± 0.10
ASM6-Sx9x	0.28 ± 0.05	3.75 ± 0.10	3.75 ± 0.10	2.65 ± 0.10

NOTE: All dimensions are in millimeters (mm).

Figure 27: Reel Dimensions



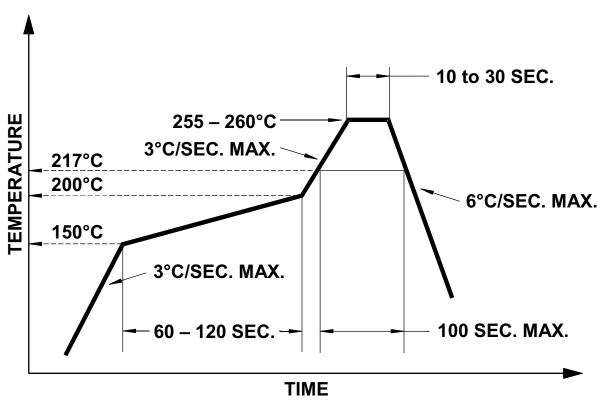
NOTE: All dimensions are in millimeters (mm).

Precautionary Notes

Soldering

- Do not perform reflow soldering more than twice.
- 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 is affected by soldering with hand soldering.

Figure 28: 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. 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 3.7 mm and ID 3.0 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.

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 (such as 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.

- 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 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:

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

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:

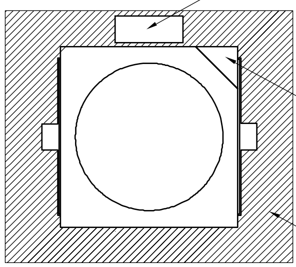
T_S = LED solder point temperature as shown in the following figure (°C)

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

I_F = Forward current (A)

V_{Fmax} = Maximum forward voltage (V)

Figure 29: 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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