BROADCOM®

Data Sheet

HDSP-311x, HDSP-313x

10.16-mm (0.4-in.) Single-Digit General-Purpose Seven-Segment Display

Description

This Broadcom® 10.16-mm (0.4-in.) LED single-digit seven-segment display uses industry-standard size package and pinout. The device is available in either common anode or common cathode. The choice of colors includes red, green, deep red, and yellow. The gray face displays are suitable for indoor use.

Applications

- Suitable for indoor use.
- Not recommended for industrial applications. See the operating temperature range in the Absolute Maximum Ratings table (see note).
- Extreme temperature cycling not recommended.

NOTE: For additional details, contact your local Broadcom sales office or an authorized distributor.

Features

- Industry-standard size
- Industry-standard pinout:
  - 10.16-mm (0.4-in.) character height
  - DIP lead on 2.54 mm
- Choice of colors:
  - Red, green, deep red, and yellow
- Excellent appearance:
  - Optimum contrast achieved on gray surface upon light-up
  - ± 50° viewing angle
- Design flexibility:
  - Common anode right-hand decimal point or common cathode right-hand decimal point
- Categorized for luminous intensity:
  - Green and yellow categorized for color

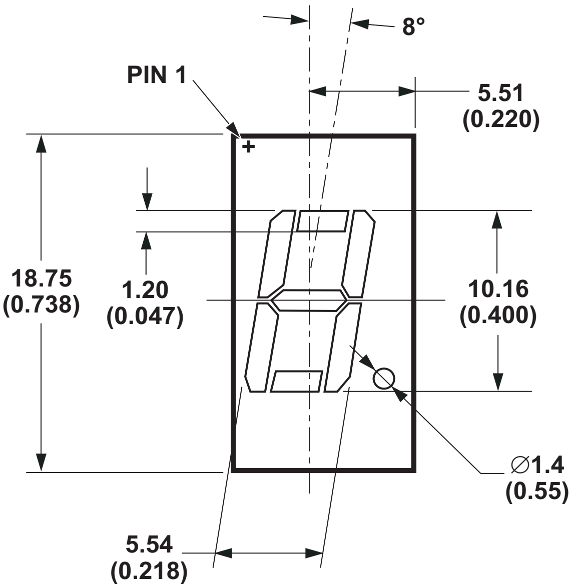
Devices

Red	Green	Deep Red	Yellow	Description	Package Drawing
HDSP-311E	HDSP-311G	HDSP-311A	HDSP-311Y	Common Anode Right-Hand Decimal	A
HDSP-313E	HDSP-313G	HDSP-313A	HDSP-313Y	Common Cathode Right-Hand Decimal	B

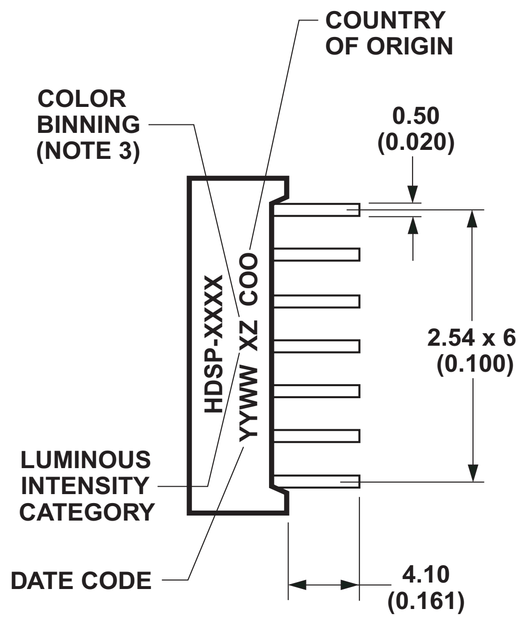
Package Dimensions

Package Drawing A

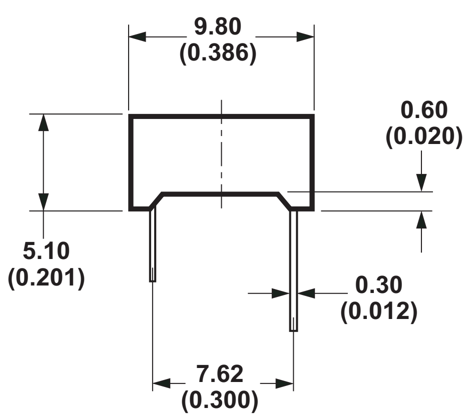
FRONT VIEW

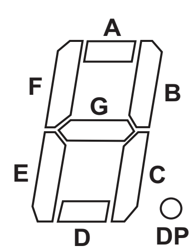


TOP-END VIEW



SIDE VIEW



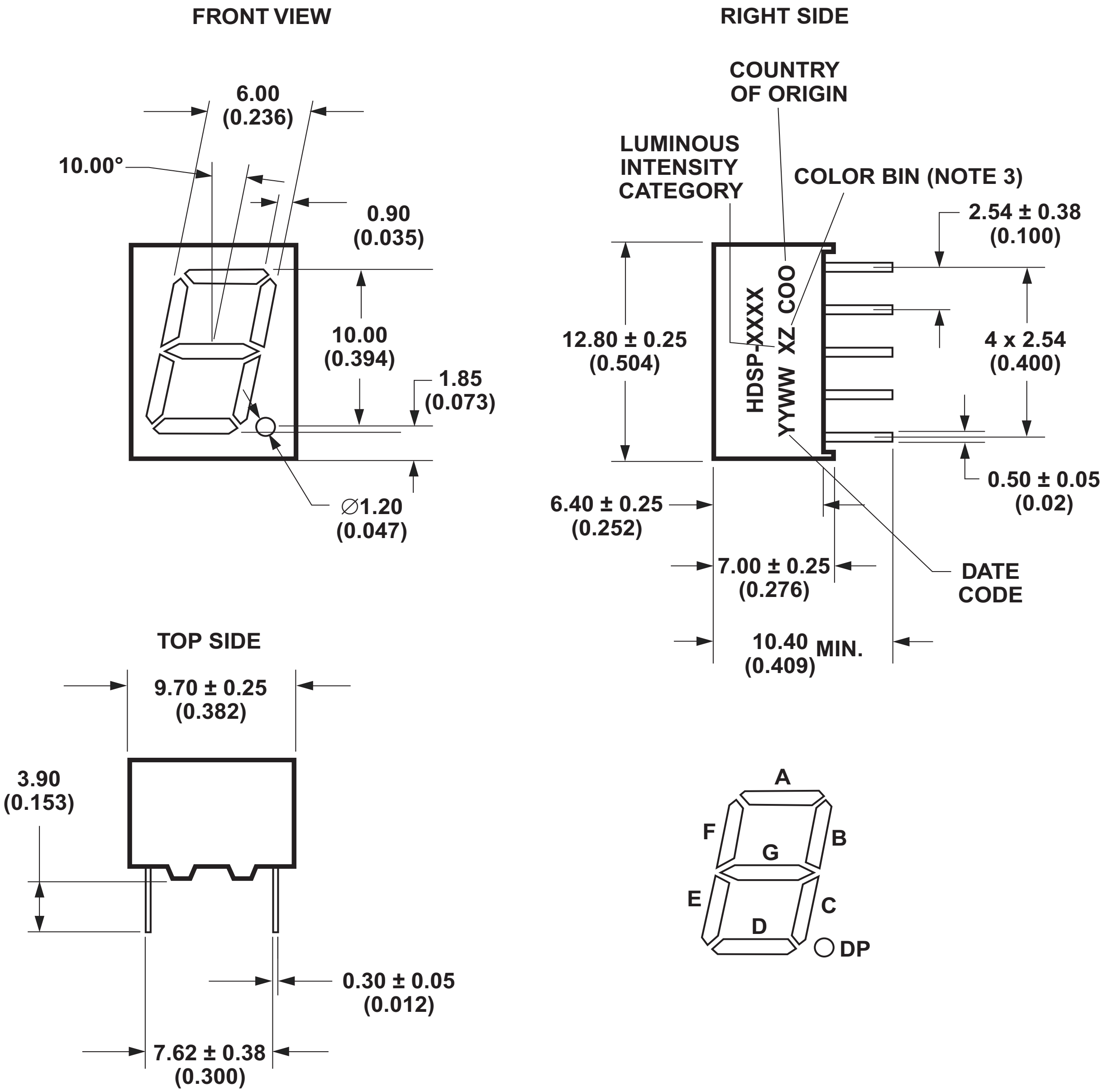


NOTE: NO PINS 4, 5, 6, AND 12

NOTE:

1. All dimensions are in millimeters (inches).
2. Tolerance is 0.25 mm (0.01 in.) unless otherwise stated.
3. For yellow and green series products only.

Package Drawing B

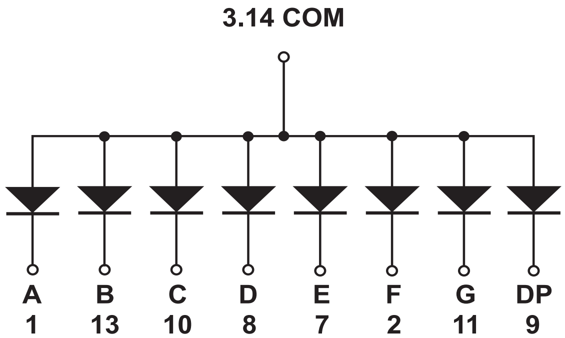


NOTE:

1. All dimensions are in millimeters (inches).
2. Tolerance is 0.25 mm (0.01 in.) unless otherwise stated.
3. For yellow and green series products only.

Internal Circuit Diagram

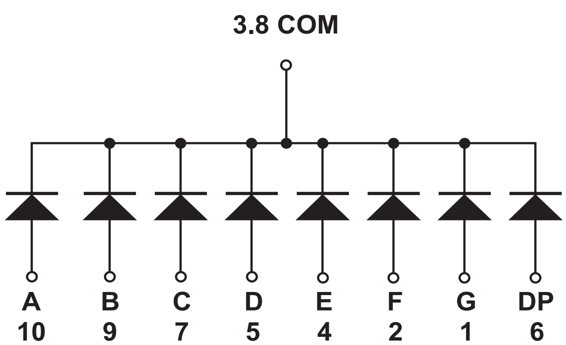
Common Anode Right-Hand Decimal



HDSP-311E/311G/311A/311Y

PIN No.	CONNECTION
1	CATHODE A
2	CATHODE F
3	COMMON ANODE
7	CATHODE E
8	CATHODE D
9	CATHODE DP
10	CATHODE C
11	CATHODE G
13	CATHODE B
14	COMMON ANODE
PINS 4, 5, 6, 12: NO PIN	

Common Cathode Right-Hand Decimal



HDSP-313E/313G/313A/313Y

PIN NO.	CONNECTION
1	ANODE G
2	ANODE F
3	COMMON CATHODE
4	ANODE E
5	ANODE D
6	ANODE DP
7	ANODE C
8	COMMON CATHODE
9	ANODE B
10	ANODE A

Absolute Maximum Ratings at T_A = 25°C

Description	Red HDSP-31xE	Green HDSP-31xG	Deep Red HDSP-31xA	Yellow HDSP-31xY	Units
Power Dissipation Segment	62.5	62.5	52	50	mW
Forward Current Segment	25[a]	25[b]	20[c]	20[d]	mA
Peak Forward Current per Segment[e]	90	90	60	60	mA
Operating Temperature Range	–40 to +85	–40 to +85	–40 to +85	–40 to +85	°C
Storage Temperature Range	–40 to +85	–40 to +85	–40 to +85	–40 to +85	°C
Reverse Voltage per Segment or DP[f]	5	5	5	5	V
Wave Soldering Temperature for 3 Seconds (at 2-mm distance from the body)	250	250	250	250	°C

a. Derate linearly as shown in Figure 4.

b. Derate linearly as shown in Figure 8.

c. Derate linearly as shown in Figure 12.

d. Derate linearly as shown in Figure 16.

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

f. Reverse voltage is for LED testing purposes and is not recommended to be used as an application condition.

Electrical/Optical Characteristics at T_A = 25°C

Device HDSP-	Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Red							
311E 313E	Luminous Intensity/Segment[a, b, c]	I_V	2.00	3.60	—	mcd	I_F = 10 mA
	Forward Voltage[d]	V_F	—	1.95	2.50	V	I_F = 20 mA
	Peak Wavelength	λ_P	—	633	—	nm	
	Dominant Wavelength[e]	λ_d	—	622	—	nm	
	Reverse Voltage[f]	V_R	5	—	—	V	I_R = 100 μA
Green							
311G 313G	Luminous Intensity/Segment[a, b, c]	I_V	1.25	3.00	—	mcd	I_F = 10 mA
	Forward Voltage[d]	V_F	1.80	2.10	2.50	V	I_F = 20 mA
	Peak Wavelength	λ_P	—	572	—	nm	
	Dominant Wavelength[e]	λ_d	—	570	—	nm	
	Reverse Voltage[f]	V_R	5	—	—	V	I_R = 100 μA
Deep Red							
311A 313A	Luminous Intensity/Segment[a, b, c]	I_V	3.20	7.50	—	mcd	I_F = 10 mA
	Forward Voltage[d]	V_F	—	2.00	2.60	V	I_F = 20 mA
	Peak Wavelength	λ_P	—	660	—	nm	
	Dominant Wavelength[e]	λ_d	—	640	—	nm	
	Reverse Voltage[f]	V_R	5	—	—	V	I_R = 100 μA

Device HDSP-	Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Yellow							
311Y 313Y	Luminous Intensity/Segment[a, b, c]	I_V	1.25	1.90	—	mcd	I_F = 10 mA
	Forward Voltage[d]	V_F	—	2.10	2.50	V	I_F = 20 mA
	Peak Wavelength	λ_P	—	592	—	nm	
	Dominant Wavelength[e]	λ_d	—	588	—	nm	
	Reverse Voltage[f]	V_R	5	—	—	V	I_R = 100 μA

a. The luminous intensity, I_V, is measured at the mechanical axis of the package.

b. The optical axis is closely aligned with the mechanical axis of the package.

c. Tolerance is ±15%.

d. Forward voltage tolerance is ± 0.1V.

e. The dominant wavelength, λ_d, is derived from the CIE Chromaticity Diagram and represents the perceived color of the device.

f. Reverse voltage is for product testing only. Long-term reverse bias is not recommended for customer applications.

Intensity Bin Limits (mcd at 10 mA)

Red

I_V Bin Category	Min.	Max.
I	2.001	3.200
J	3.201	5.050
K	5.051	8.000

Tolerance for each bin limit is ± 15%.

Green

I_V Bin Category	Min.	Max.
H	1.251	2.000
I	2.001	3.200
J	3.201	5.050
K	5.051	8.000

Tolerance for each bin limit is ±15%.

Deep Red

I_V Bin Category	Min.	Max.
J	3.201	5.050
K	5.051	8.000
L	8.001	12.650

Tolerance for each bin limit is ± 15%.

Yellow

I_V Bin Category	Min.	Max.
H	1.251	2.000
I	2.001	3.200
J	3.201	5.050

Tolerance for each bin limit is ± 15%.

Color Bin Limits (nm at 10 mA)

Color	Bin	Dominant Wavelength (nm)	
		Min.	Max.
Green	3	569.1	571.1
	4	571.1	573.1
	5	573.1	585.5
Yellow	1	585.5	588.5
	2	588.5	591.5
	3	591.5	594.5

Tolerance for each bin limit is 1 nm.

Red

Figure 1: Relative Intensity vs. Wavelength

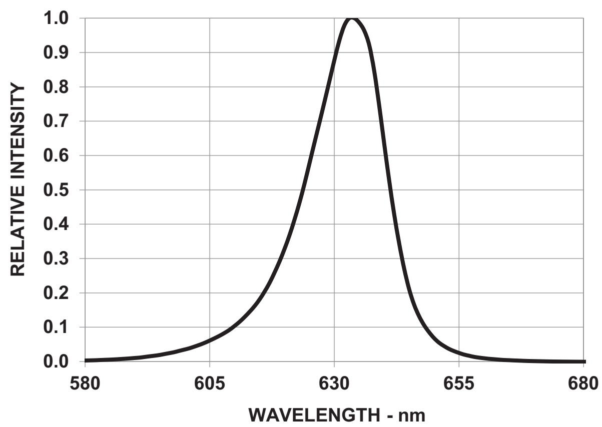


Figure 2: Forward Current vs. Forward Voltage

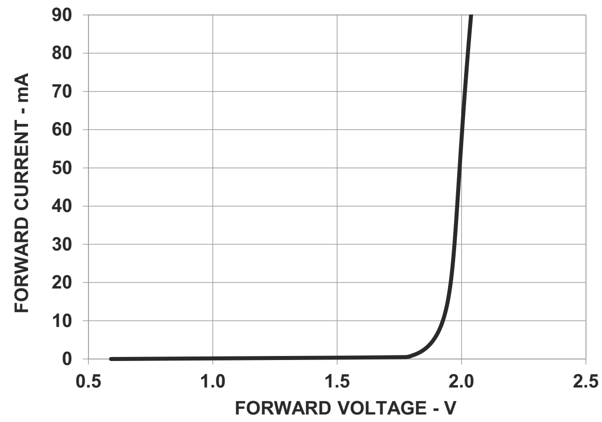


Figure 3: Relative Luminous Intensity vs. Forward Current

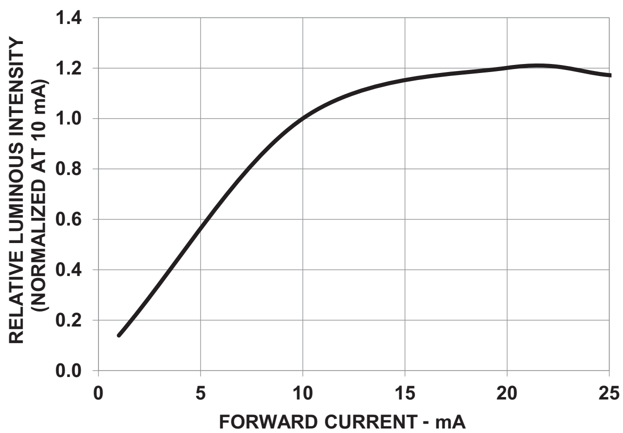
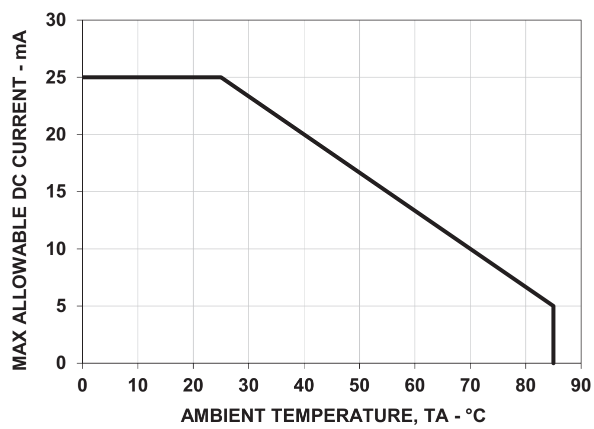


Figure 4: Maximum Forward Current vs. Ambient Temperature



Green

Figure 5: Relative Intensity vs. Wavelength

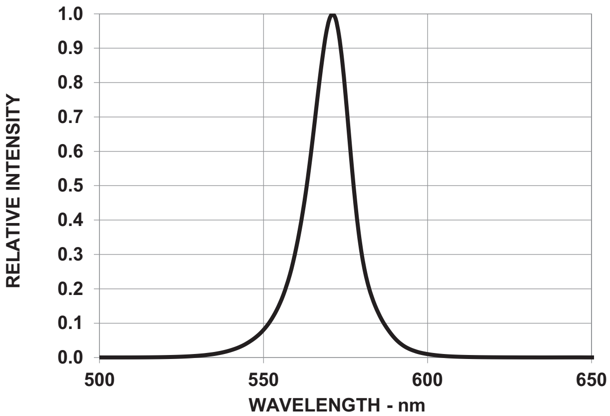


Figure 6: Forward Current vs. Forward Voltage

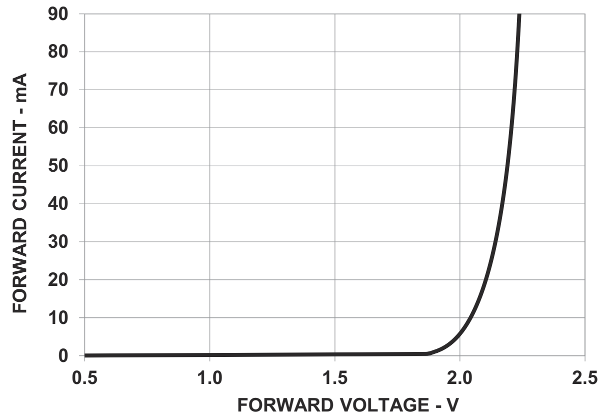


Figure 7: Relative Luminous Intensity vs. Forward Current

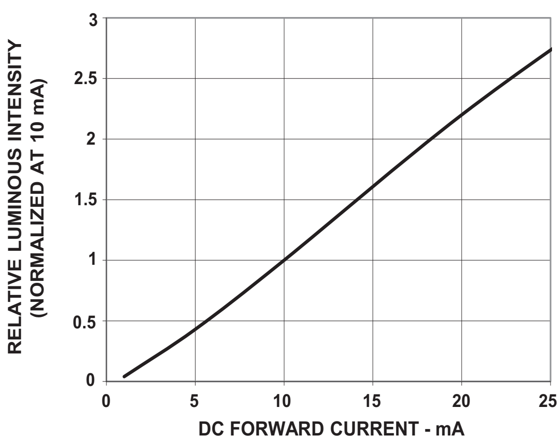
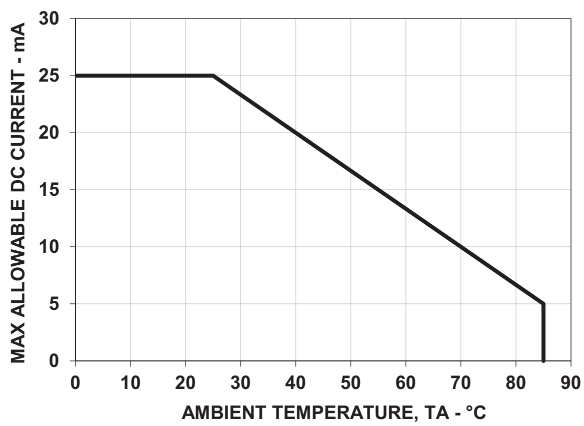


Figure 8: Maximum Forward Current vs. Ambient Temperature



Deep Red

Figure 9: Relative Intensity vs. Wavelength

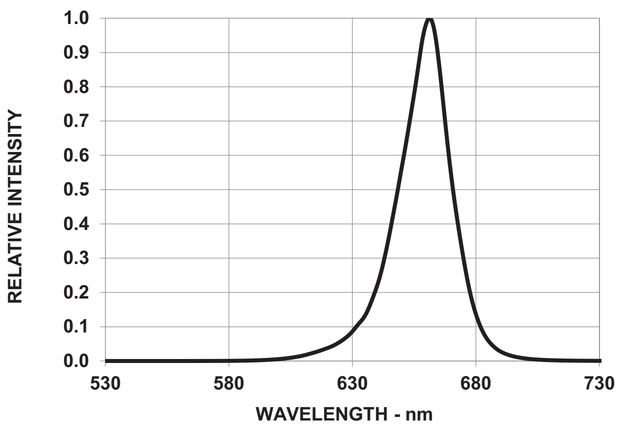


Figure 10: Forward Current vs. Forward Voltage

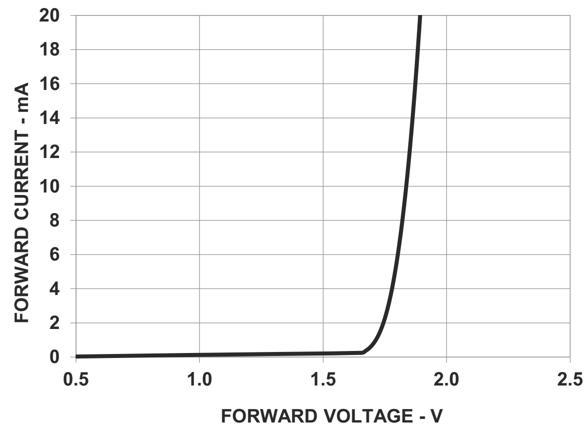


Figure 11: Relative Luminous Intensity vs. Forward Current

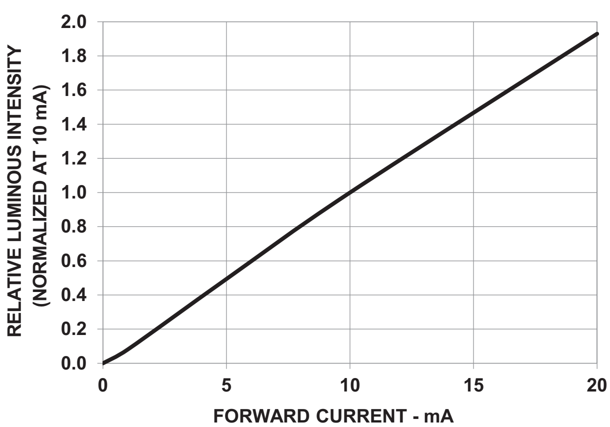
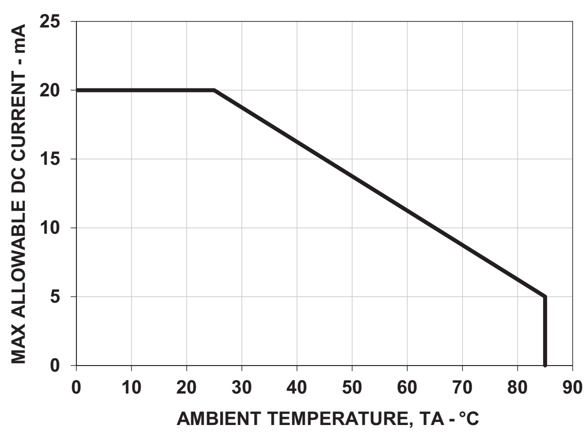


Figure 12: Maximum Forward Current vs. Ambient Temperature



Yellow

Figure 13: Relative Intensity vs. Wavelength

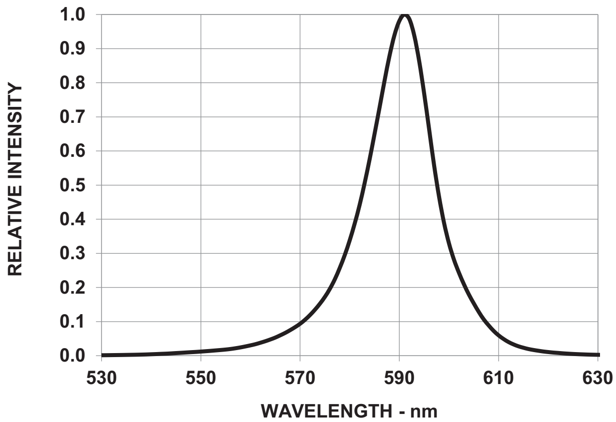


Figure 14: Forward Current vs. Forward Voltage

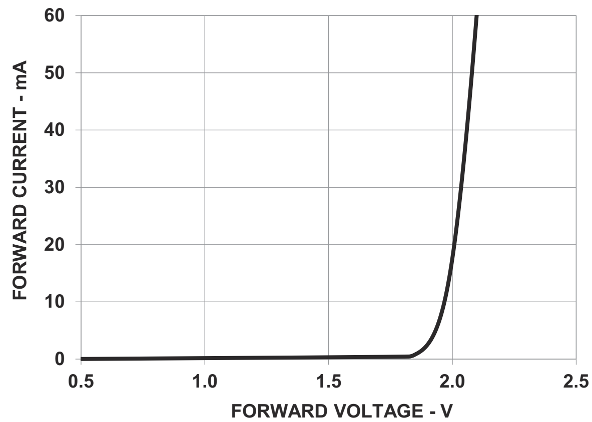


Figure 15: Relative Luminous Intensity vs. Forward Current

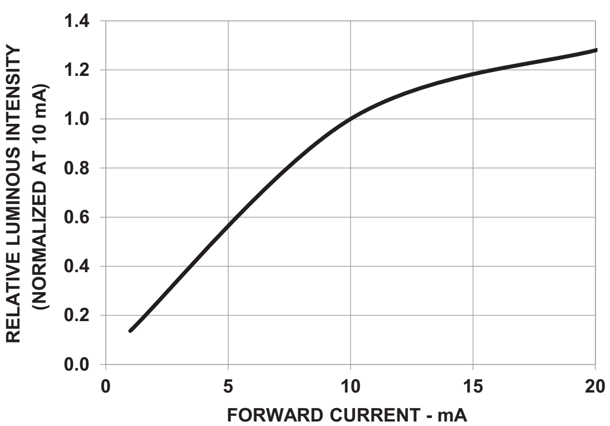
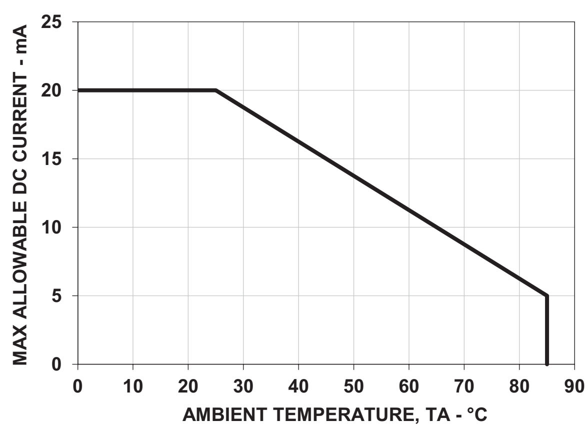


Figure 16: Maximum Forward Current vs. Ambient Temperature

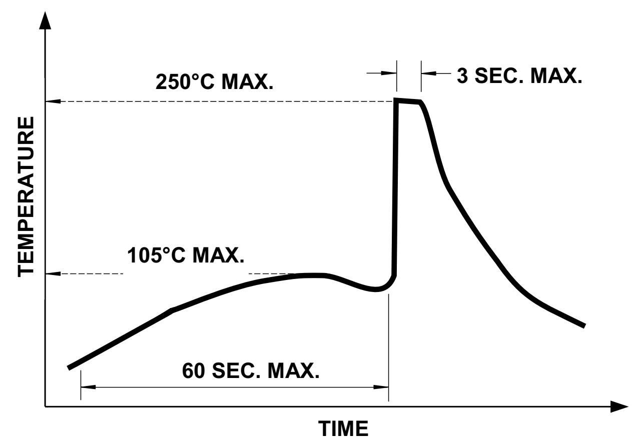


Precautionary Notes

Soldering and Handling Precautions

- Set and maintain the wave soldering parameters according to the recommended temperature and dwell time. Perform daily checks on the profile to ensure that it conforms to the recommended conditions. Exceeding these conditions will overstress the LEDs and cause premature failures.
- Use only bottom preheaters to reduce thermal stress experienced by the LEDs.
- Recalibrate the soldering profile before loading a new type of PCB. A PCB with a different size and design (component density) will have a different heat capacity and might cause a change in temperature experienced by the PCB if the same wave soldering setting is used.
- Do not perform wave soldering more than once.
- Loosely fit any alignment fixture used during wave soldering and do not apply stress on the LEDs. Use a nonmetal material because it absorbs less heat during the wave soldering process.
- At elevated temperatures, the LEDs are more susceptible to mechanical stress. Allow the PCB to be sufficiently cooled to room temperature before handling. Do not apply stress to the LED when it is hot.
- Use wave soldering to solder the LED. Use hand soldering only for rework or touch-up if unavoidable, but it must be strictly controlled to following conditions:
  - Soldering iron tip temperature = 315°C maximum
  - Soldering duration = 2 seconds maximum
  - Number of cycles = 1 only
  - Power of soldering iron = 50W maximum
- For ESD-sensitive devices, apply proper ESD precautions at the soldering station. Use only an ESD-safe soldering iron.
- Do not touch the LED package body with the soldering iron except for the soldering terminals because it may cause damage to the LED.
- Confirm beforehand whether the functionality and performance of the LED are affected by soldering with hand soldering.
- Keep the heat source at least 1.6 mm away from the LED body during soldering.
- Design an appropriate hole size to avoid problems during insertion.
- Do not use cleaning agents from the ketone family (acetone, methyl ethylketone, and so on) or from the chlorinated hydrocarbon family (methylene chloride, trichloroethylene, carbon tetrachloride, and so on) to clean the LED displays. All of these solvents attack or dissolve the encapsulating epoxies used to form the package of plastic LED parts.
- For the purposes of cleaning, wash with DI water only. Perform the cleaning process at room temperature only. Clear any water or moisture from the LED display immediately after washing.
- Use *No clean* solder paste for soldering.

Figure 17: Recommended Wave Soldering Profile



NOTE: The measurements are performed with a thermocouple mounted at the bottom of the PCB.

Application Precautions

- The drive current of the LED must not exceed the maximum allowable limit across temperature as stated in the data sheet. Use constant current driving to ensure consistent performance.
- The circuit design must cater to the entire 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 (such as 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.
- 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.

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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