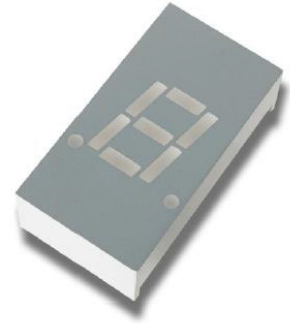


# HDSP-332E/333x Series

## 7.62-mm (0.3-inch) General-Purpose Seven-Segment Display



### Description

The Broadcom<sup>®</sup> HDSP-332E/333x Series 7.62-mm (0.3-inch) LED 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 GaP high efficiency red (HER), GaP green, and AlInGaP deep red. The gray face displays are suitable for indoor use.

### Applications

- Suitable for indoor use
- Not recommended for industrial application, i.e., operating temperature requirements exceeding +85°C or below -25°C<sup>1</sup>
- Extreme temperature cycling not recommended

### Features

- Industry-standard size
- Industry-standard pinout
  - 7.62-mm (0.4 inch) character height
  - DIP lead on 2.54 mm
- Choice of colors
  - High efficiency red (HER), GaP green, AlInGaP deep red
- Excellent appearance
  - Evenly lighted segments gray package gives optimum contrast
  - ±50° viewing angle
- Design flexibility
  - Common anode or common cathode
  - Single digit
  - Left and right hand decimal point
- Categorized for luminous intensity
  - Green categorized for color

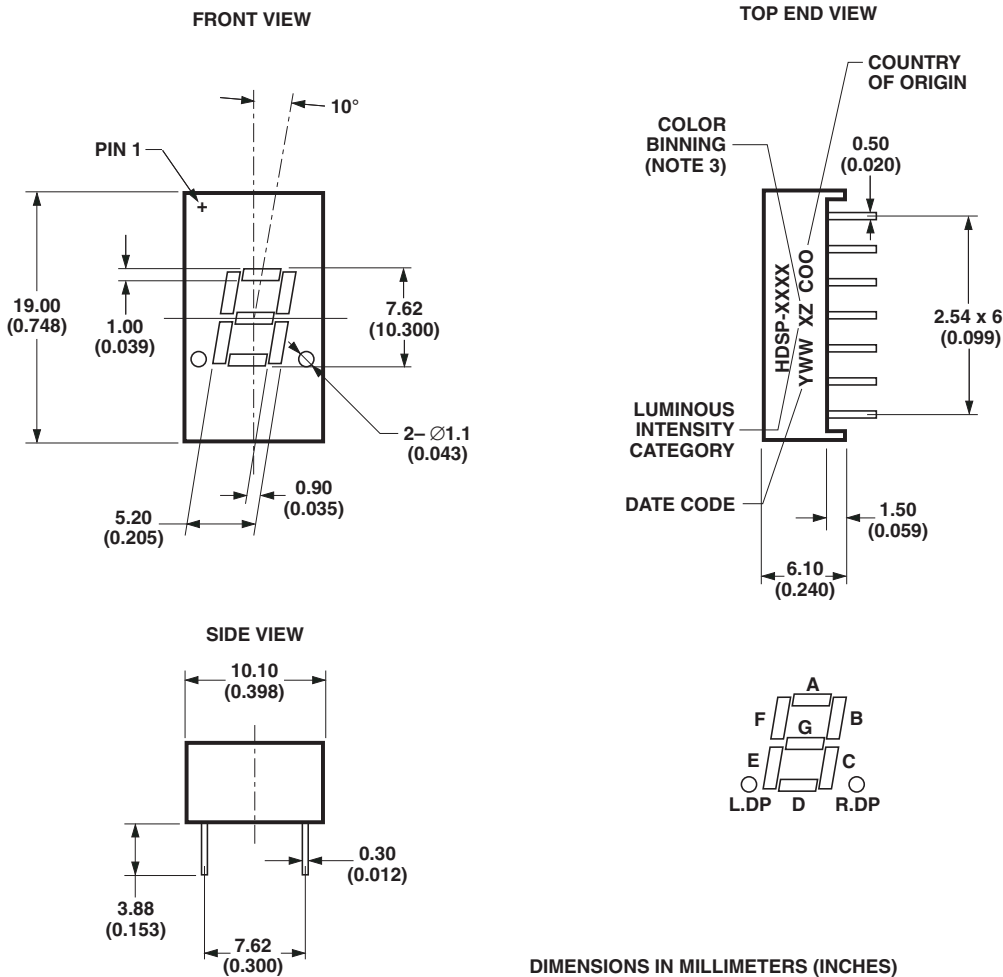
### Ordering Information

GaP HER	GaP Green	AlInGaP Deep Red	Description	Package Drawing
HDSP-332E	—	—	Common Anode, Right Hand and Left Hand Decimal without Pin 4, 5, and 12	A
HDSP-333E	HDSP-333G	HDSP-333A	Common Cathode, Right Hand Decimal	B

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

# Package Dimensions

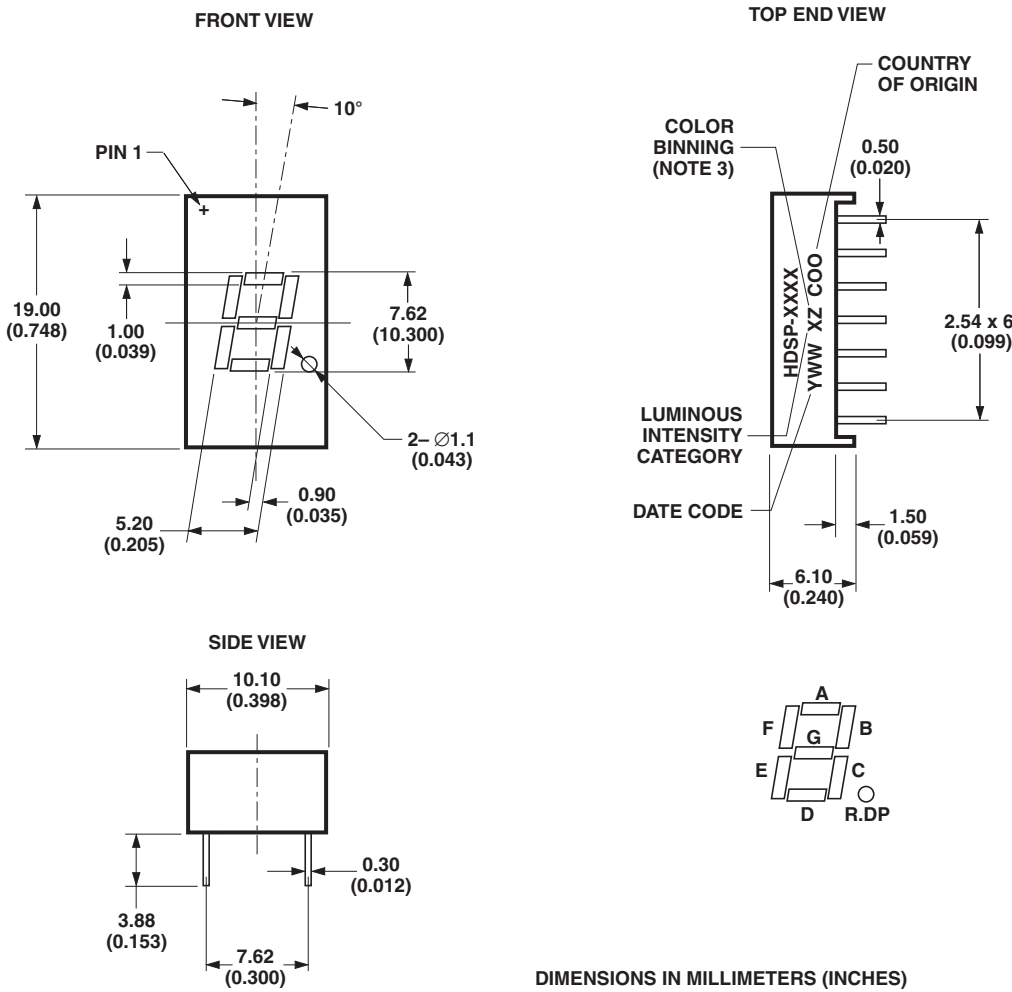
Figure 1: Package Drawing A



NOTE: HDSP-332E DOES NOT HAVE PIN 4, 5, AND 12.

DIMENSIONS IN MILLIMETERS (INCHES)

Figure 2: Package Drawing B



DIMENSIONS IN MILLIMETERS (INCHES)

# Internal Circuit Diagram

Figure 3: Common Anode

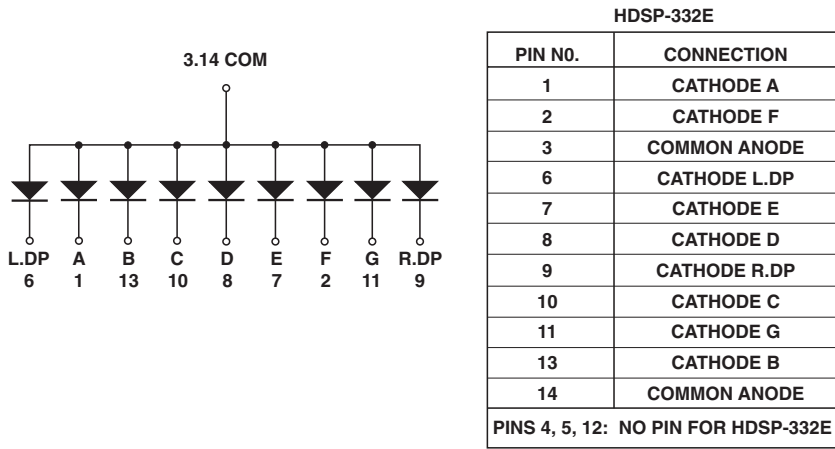
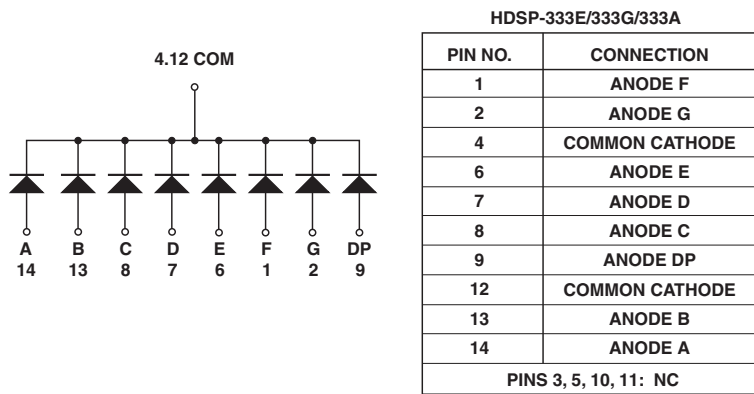


Figure 4: Common Cathode



## Absolute Maximum Ratings at $T_A = 25^\circ\text{C}$

Description	HER HDSP-33xE	Green HDSP-33xG	Deep Red HDSP-33xA	Unit
Power Dissipation Segment	65	65	52	mW
Forward Current Segment	25 <sup>a</sup>	25 <sup>b</sup>	20 <sup>c</sup>	mA
Peak Forward Current per Segment	100 <sup>d</sup>	100 <sup>d</sup>	60 <sup>e</sup>	mA
Operating Temperature Range	-35 to +85	-35 to +85	-40 to +85	°C
Storage Temperature Range	-35 to +85	-35 to +85	-40 to +85	°C
Reverse Voltage per Segment or DP	Not designed for reverse bias operation			V
Wave Soldering Temperature for 3 Seconds (at 2-mm Distance from the Body)	250	250	250	°C

- a. Derate linearly as shown in [Figure 5](#).
- b. Derate linearly as shown in [Figure 9](#).
- c. Derate linearly as shown in [Figure 16](#).
- d. Duty factor = 10%, frequency = 10 kHz.
- e. Duty factor = 10%, frequency = 1 kHz.

## Electrical/Optical Characteristics at $T_A = 25^\circ\text{C}$

Device HDSP-	Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
<b>High Efficiency Red (HER)</b>							
332E 333E	Luminous Intensity/Segment <sup>a,b,c</sup>	$I_V$	—	1.15	—	mcd	$I_F = 5\text{ mA}$
			0.8	1.80	—		$I_F = 10\text{ mA}$
	Forward Voltage <sup>d</sup>	$V_F$	—	2.05	2.40	V	$I_F = 20\text{ mA}$
	Peak Wavelength	$\lambda_P$	—	635	—	nm	
	Dominant Wavelength <sup>e</sup>	$\lambda_d$	—	620	—	nm	
Reverse Voltage <sup>f</sup>	$V_R$	5	—	—	V	$I_R = 100\ \mu\text{A}$	
<b>Green</b>							
333G	Luminous Intensity/Segment <sup>a,b,c</sup>	$I_V$	0.8	2.00	—	mcd	$I_F = 10\text{ mA}$
			—	2.07	—		V
	—	1.80	2.25	2.60	$I_F = 20\text{ mA}$		
	Peak Wavelength	$\lambda_P$	—	568	—	nm	
	Dominant Wavelength <sup>e</sup>	$\lambda_d$	—	573	—	nm	
Reverse Voltage <sup>f</sup>	$V_R$	5	—	—	V	$I_R = 100\ \mu\text{A}$	

Device HDSP-	Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
<b>Deep Red</b>							
333A	Luminous Intensity/Segment <sup>a,b,c</sup>	$I_V$	—	3.93	—	mcd	$I_F = 5 \text{ mA}$
			2.001	4.20	—		$I_F = 10 \text{ mA}$
	Forward Voltage <sup>d</sup>	$V_F$	—	2.0	2.6	V	$I_F = 20 \text{ mA}$
	Peak Wavelength	$\lambda_P$	—	660	—	nm	
	Dominant Wavelength <sup>e</sup>	$\lambda_d$	—	640	—	nm	
Reverse Voltage <sup>f</sup>	$V_R$	5	—	—	V	$I_R = 100 \mu\text{A}$	

- 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  $\pm 15\%$
- d. Forward voltage tolerance is  $\pm 0.1\text{V}$ .
- e. The dominant wavelength,  $\lambda_d$ , is derived from the CIE Chromaticity Diagram and represents the perceived color of the device.
- f. Indicates product final test condition. Long-term reverse bias is not recommended.

## Intensity Bin Limits (mcd at 10 mA)

Bin Name	HER/Green		Deep Red	
	Min.	Max.	Min.	Max.
G	0.801	1.250	NA	NA
H	1.251	2.000	NA	NA
I	2.001	3.200	2.001	3.200
J	NA	NA	3.201	5.050
K	NA	NA	5.051	8.000

**NOTE:** Tolerance for each bin limit is  $\pm 15\%$ .

## 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

**NOTE:** Tolerance for each bin limit is 1 nm.

# High Efficiency Red (HER) Graphs

Figure 5: Maximum Allowable Average or DC Current vs. Ambient Temperature

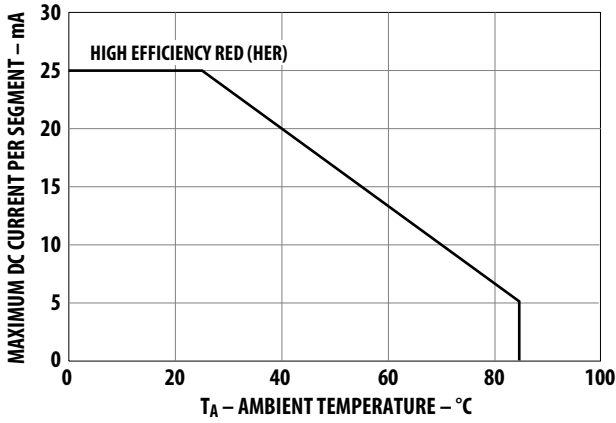


Figure 6: Forward Current vs. Forward Voltage

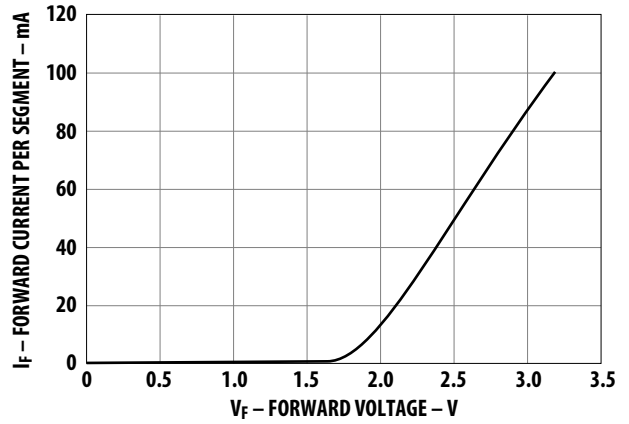


Figure 7: Relative Luminous Intensity vs. DC Forward Current

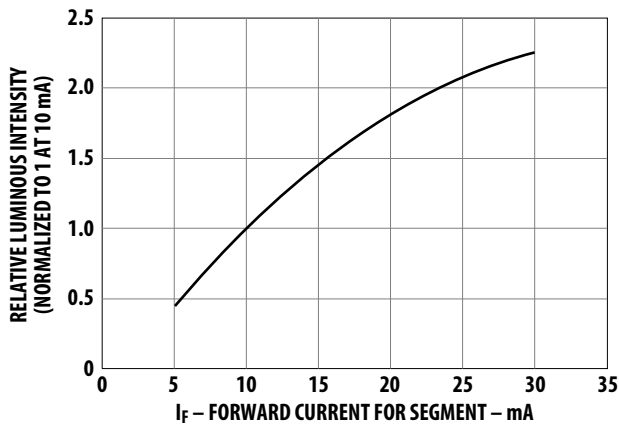
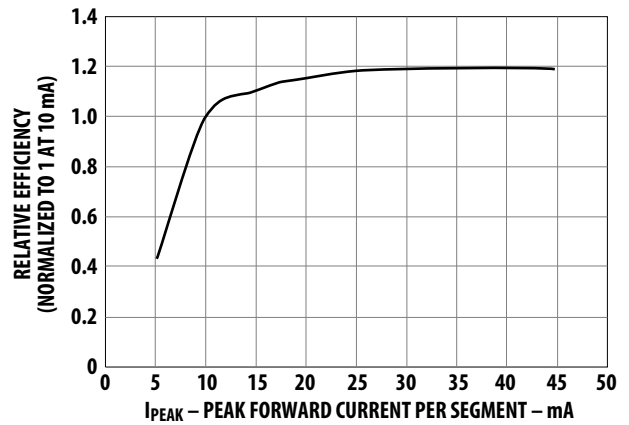


Figure 8: Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current



# Green Graphs

Figure 9: Maximum Allowable Average or DC Current vs. Ambient Temperature

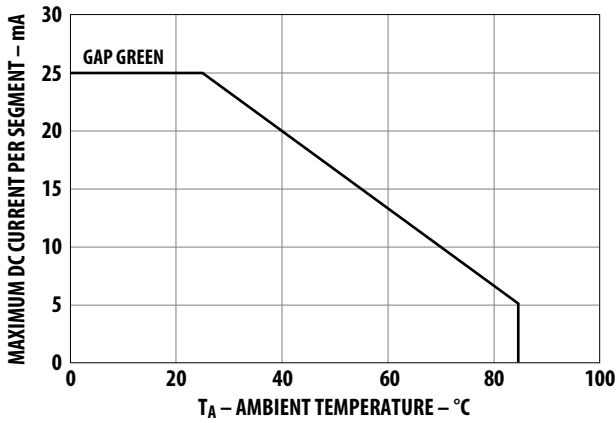


Figure 10: Forward Current vs. Forward Voltage

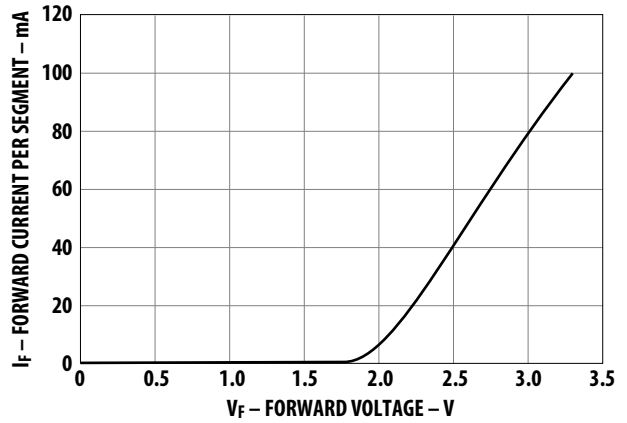


Figure 11: Relative Luminous Intensity vs. DC Forward Current

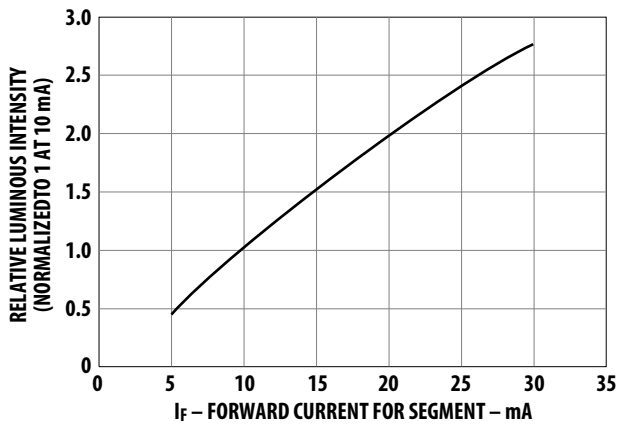
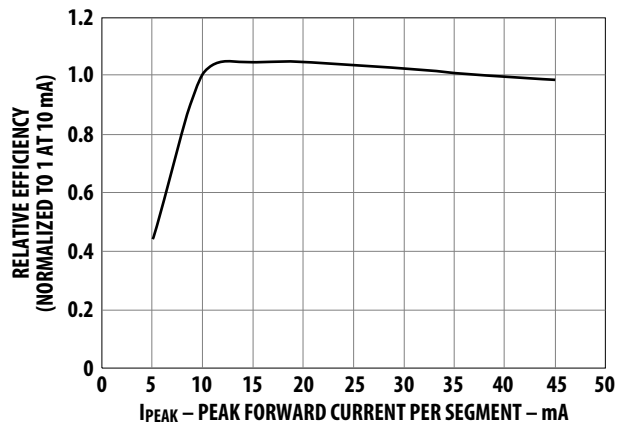


Figure 12: Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current





# Deep Red Graphs

Figure 13: Spectral Power Distribution

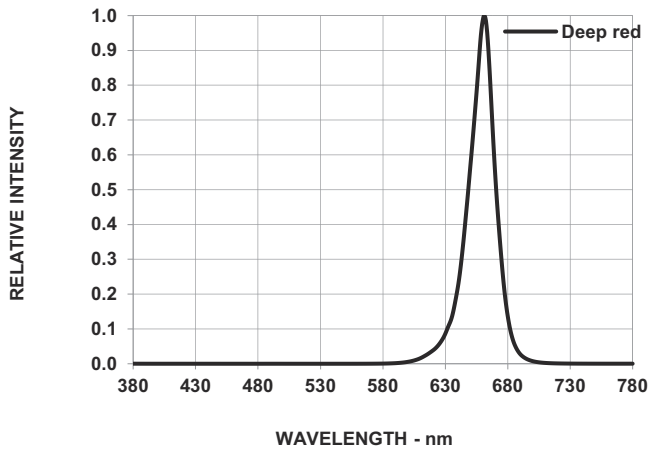


Figure 14: Forward Current vs. Forward Voltage

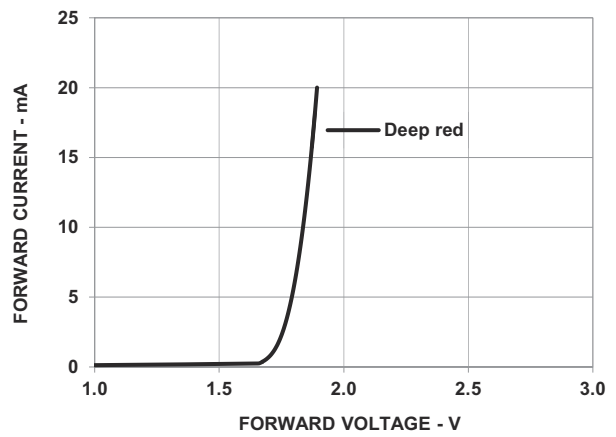


Figure 15: Relative Luminous Intensity vs. Forward Current

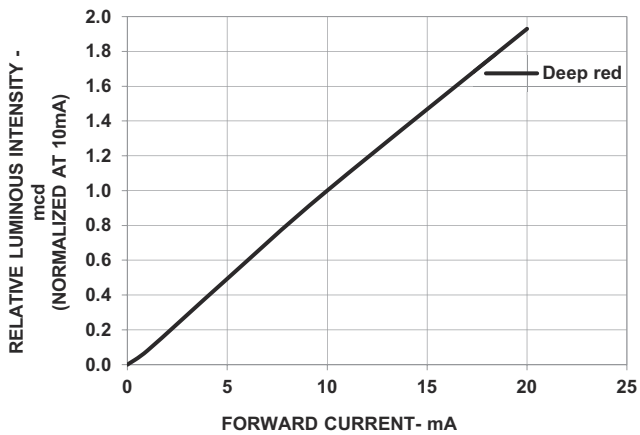
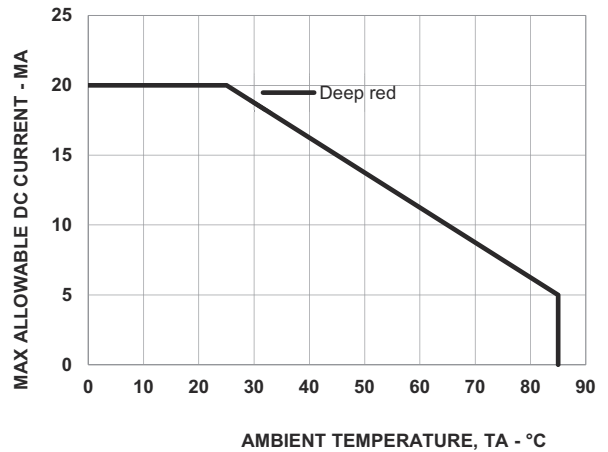


Figure 16: Maximum Forward Current vs. Ambient Temperature



## Precautionary Notes

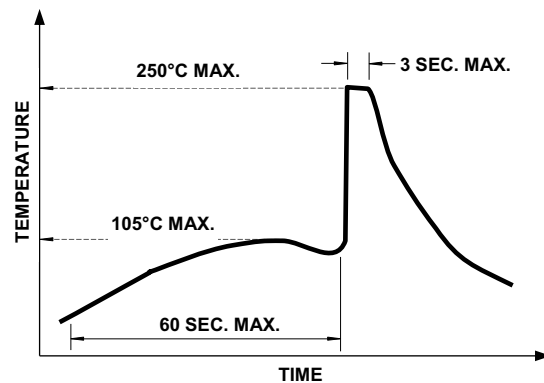
### Soldering and Handling Precautions

- 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 is always conforming to the recommended conditions. Exceeding these conditions will over-stress 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. PCBs with different sizes and designs (component density) will have different heat capacities 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.
- Any alignment fixture used during wave soldering must be loosely fitted and must not apply stress on the LEDs. Use non-metal material because it will absorb 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 cycle = 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 is 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.
- Cleaning agents from the ketone family (acetone, methyl ethylketone, and so on) and from the chlorinated hydrocarbon family (methylene chloride, trichloroethylene, carbon tetrachloride, and so on) are

not recommended for cleaning the LED displays. All of these various solvents attack or dissolve the encapsulating epoxies used to form the package of plastic LED parts.

- For the purpose of cleaning, wash with DI water only. The cleaning process should take place at room temperature only. Clear any water or moisture from the LED display immediately after washing.
- Use of *No clean* solder paste is recommended for soldering.

Figure 17: Recommended Wave Soldering Profile



**NOTE:** Figure 17 refers to measurements with thermocouple mounted at the bottom of the PCB.

### Application Precautions

- The drive current of the LED must not exceed the maximum allowable limit across temperatures 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.
- 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 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 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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