HDSP-511x, HDSP-513x, and HDSP-515A

14.22-mm (0.56-in.) General-Purpose Seven-Segment Display

Description

This 14.22-mm (0.56-in.) 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 AlInGaP Red, AlInGaP Green, AlInGaP Deep Red, and AlInGaP Yellow. The displays are suitable for indoor use.

Applications

- Suitable for indoor use
- Not recommended for industrial application, that is, operating temperature requirements exceeding +85°C or below –25°C (for additional details, contact your local Broadcom® sales office or an authorized distributor)
- Extreme temperature cycling not recommended

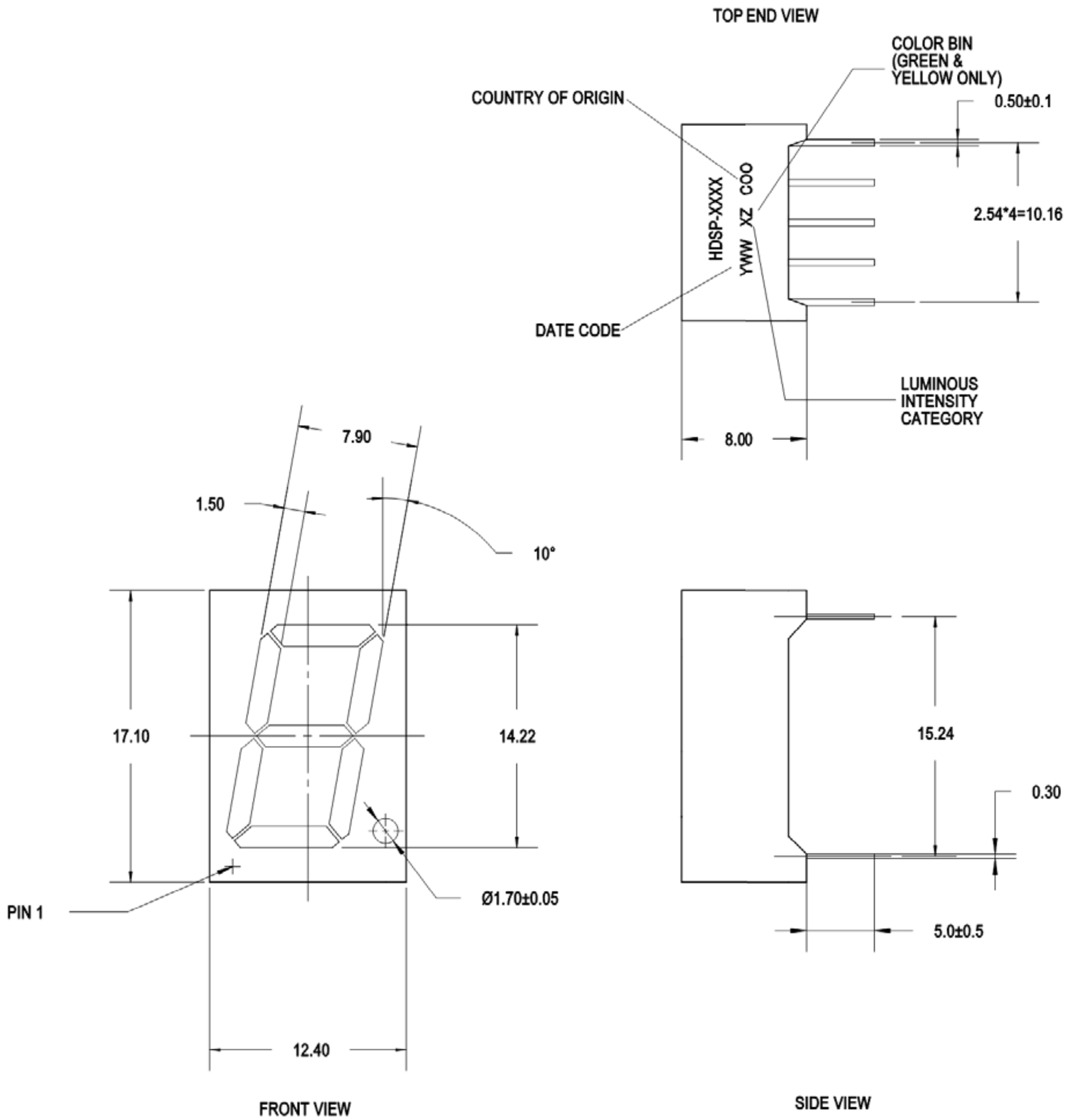
Features

- Industry-standard size
- Industry-standard pinout
  14.22-mm (0.56-in.) DIP lead on 2.54 mm
- Choice of colors
  AlInGaP Red, AlInGaP Green, AlInGaP Deep Red, and AlInGaP Yellow
- Excellent appearance
  Evenly lighted segments package gives optimum contrast
  ± 50° viewing angle
- Design flexibility
  Common anode or common cathode
  Single digit
  Right-hand decimal point
- Categorized for luminous intensity
  Green and yellow categorized for color

Devices

AlInGaP Red	AlInGaP Green	AlInGaP Deep Red	AlInGaP Yellow	Description
HDSP-511E	HDSP-511G	HDSP-511A	HDSP-511Y	Common Anode, Gray Surface, Right-Hand Decimal
HDSP-513E	HDSP-513G	HDSP-513A	HDSP-513Y	Common Cathode, Gray Surface, Right-Hand Decimal
—	—	HDSP-515A	—	Common Cathode, Black Surface, Right-Hand Decimal

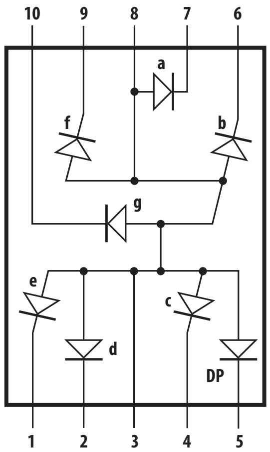
Package Dimensions



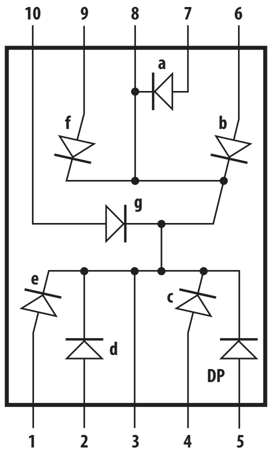
NOTE:

1. All dimensions are in millimeters (mm).
2. Tolerance is ± 0.25 mm unless otherwise specified.

Internal Circuit Diagram



COMMON ANODE



COMMON CATHODE

HDSP-511E/511G/511Y/511A		HDSP-513E/513G/513Y/513A/515A	
COMMON ANODE		COMMON CATHODE	
PIN	FUNCTION	PIN	FUNCTION
1	CATHODE e	1	ANODE e
2	CATHODE d	2	ANODE d
3	COMMON ANODE	3	COMMON CATHODE
4	CATHODE c	4	ANODE c
5	CATHODE DP	5	ANODE DP
6	CATHODE b	6	ANODE b
7	CATHODE a	7	ANODE a
8	COMMON ANODE	8	COMMON CATHODE
9	CATHODE f	9	ANODE f
10	CATHODE g	10	ANODE g

Absolute Maximum Ratings at T_A = 25°C

Description	Red HDSP-51xE	Green HDSP-51xG	Deep Red HDSP-51xA	Yellow HDSP-51xY	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
Wavesoldering 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							
511E 513E	Luminous Intensity/Segment[a, b, c]	I_V	5.05	7.50	—	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							
511G 513G	Luminous Intensity/Segment[a, b, c]	I_V	5.05	7.60	—	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							
511A 513A 515A	Luminous Intensity/Segment[a, b, c]	I_V	3.201	6.500	—	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
Yellow							
511Y 513Y	Luminous Intensity/Segment[a, b, c]	I_V	2.00	3.20	—	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. Indicates product final test condition. Long term reverse bias is not recommended.

Intensity Bin Limits (mcd at 10 mA)

Red/Green

IV Bin Category	Min.	Max.
K	5.051	8.000
L	8.001	12.650
M	12.651	20.000

Tolerance for each bin limit is ± 15%.

Deep Red

IV 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

IV 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%.

Color Bin Limits (nm)

Color	Dominant Wavelength (nm)		
	Bin	Min.	Max.
Green	3	569.1	571.0
	4	571.1	573.0
	5	573.1	575.0
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

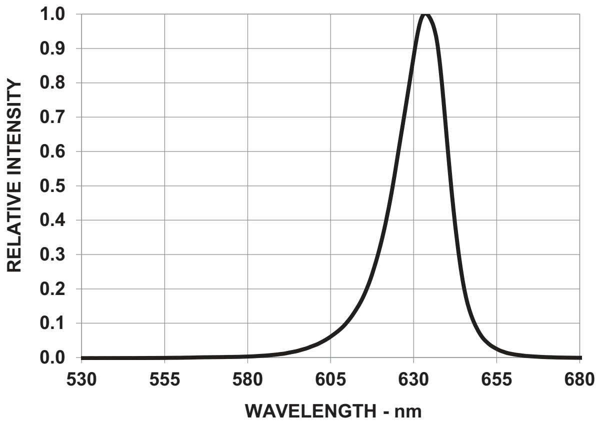


Figure 2: Forward Current vs. Forward Voltage

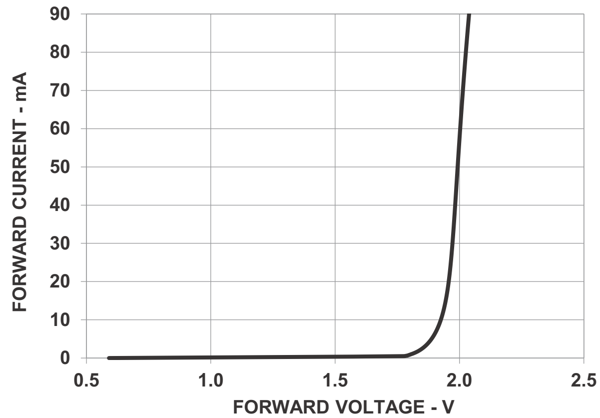


Figure 3: Relative Luminous Intensity vs. Forward Current

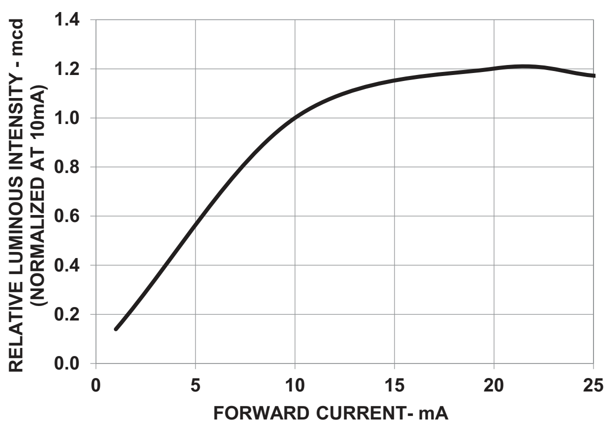
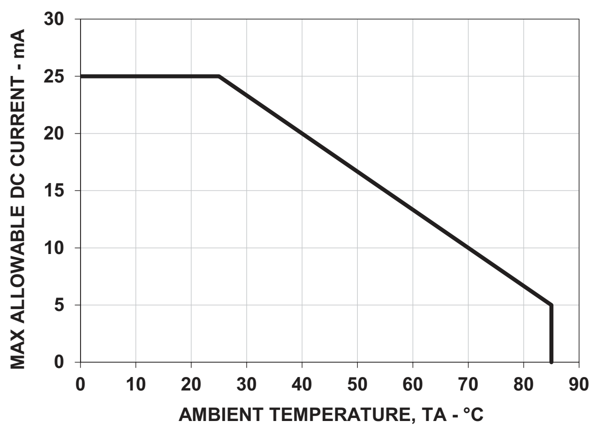


Figure 4: Maximum Forward Current vs. Ambient Temperature



Green

Figure 5: Relative Intensity vs. Wavelength

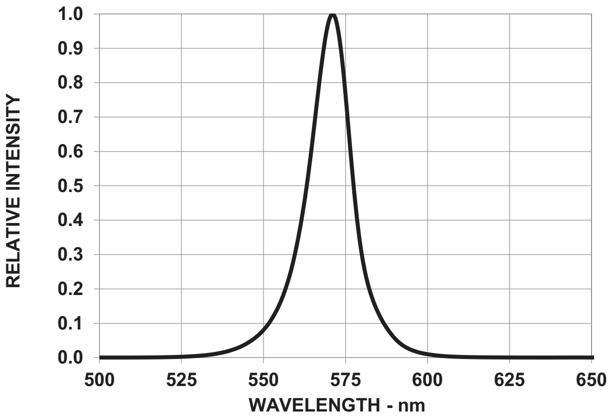


Figure 6: Forward Current vs. Forward Voltage

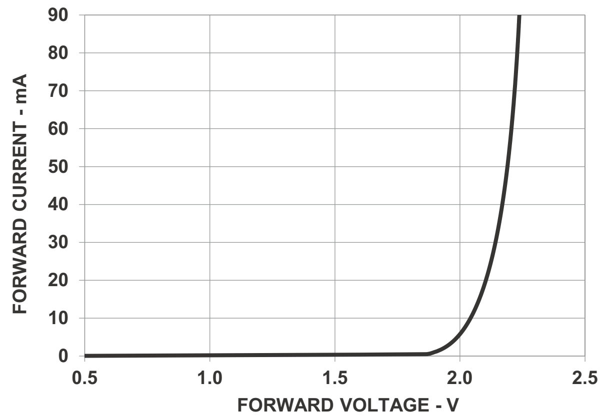


Figure 7: Relative Luminous Intensity vs. Forward Current

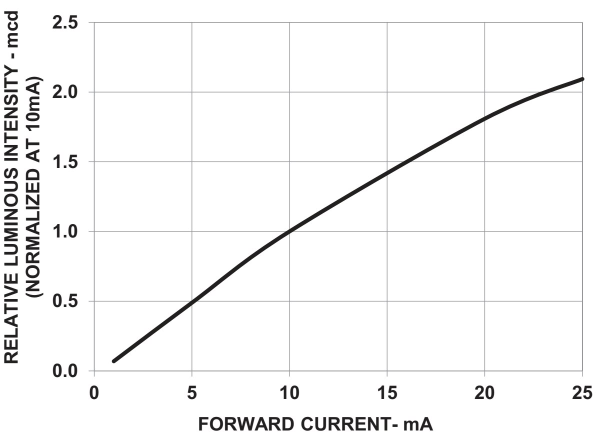
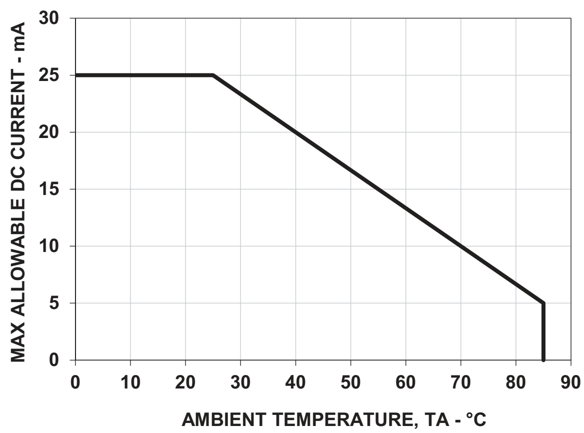


Figure 8: Maximum Forward Current vs. Ambient Temperature



Deep Red

Figure 9: Relative Intensity vs. Wavelength

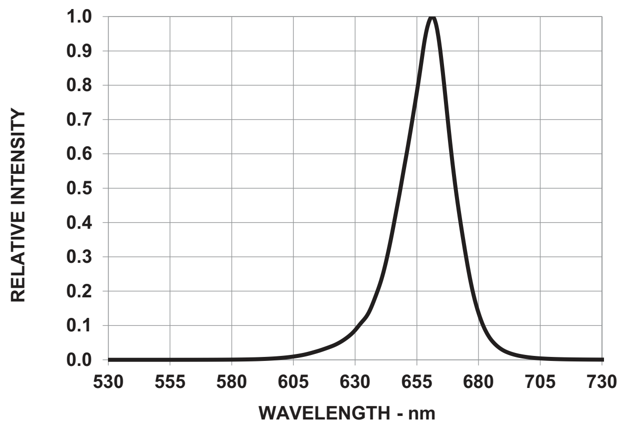


Figure 10: Forward Current vs. Forward Voltage

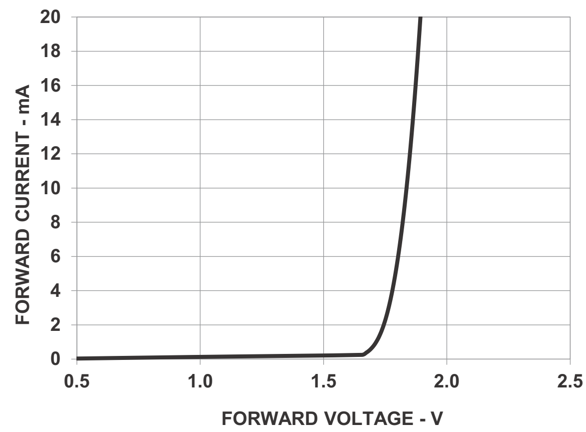


Figure 11: Relative Luminous Intensity vs. Forward Current

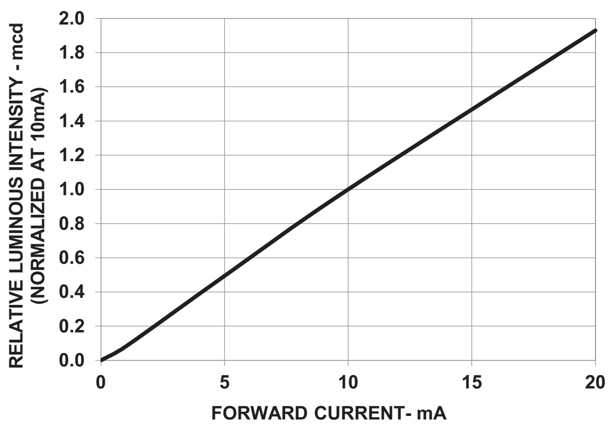
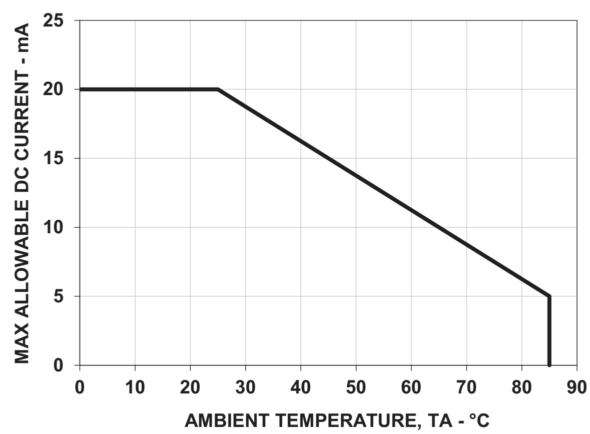


Figure 12: Maximum Forward Current vs. Ambient Temperature



Yellow

Figure 13: Relative Intensity vs. Wavelength

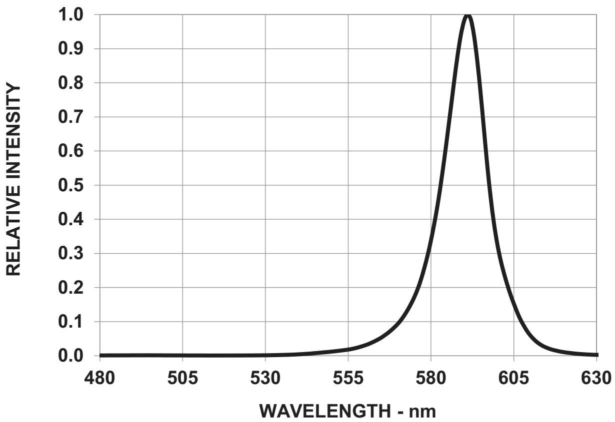


Figure 14: Forward Current vs. Forward Voltage

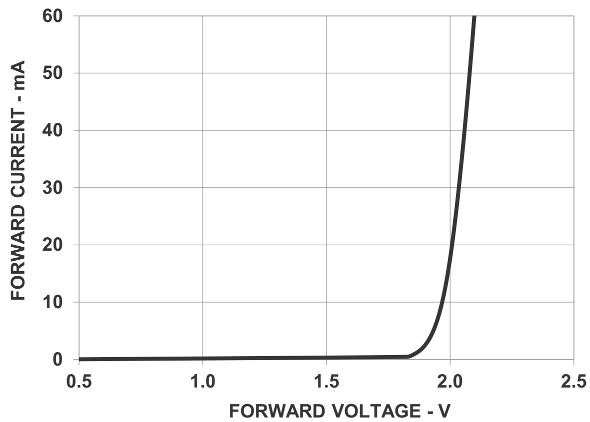


Figure 15: Relative Luminous Intensity vs. Forward Current

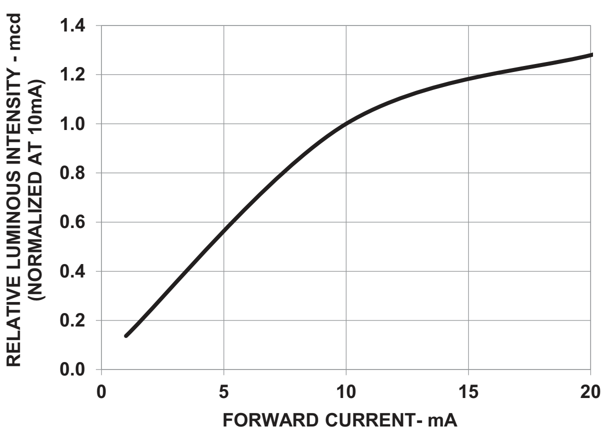
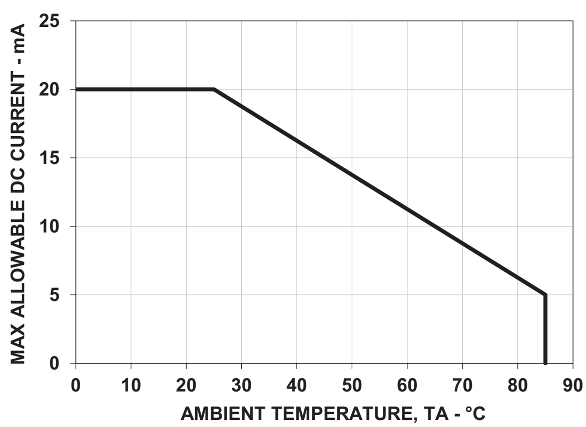


Figure 16: Maximum Forward Current vs. Ambient Temperature

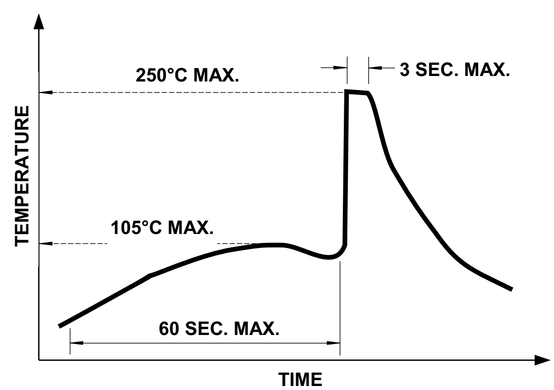


Precautionary Notes

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 always conforms 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) have 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.
- Any alignment fixture used during wave soldering must be loosely fitted and must not apply stress on the LEDs. Use 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 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 appropriate hole size to avoid problem during insertion.
- Do not use cleaning agents from the ketone family (acetone, methyl ethylketone, etc.) and from the chlorinated hydrocarbon family (methylene chloride, trichloroethylene, carbon tetrachloride, and so on) 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 *No clean* solder paste for soldering.

Figure 17: Recommended Wave Soldering Profile



NOTE: 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 temperature as stated in the data sheet. Constant current driving is recommended to ensure consistent performance.
- The circuit design must cater to the entire 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 (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. 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 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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