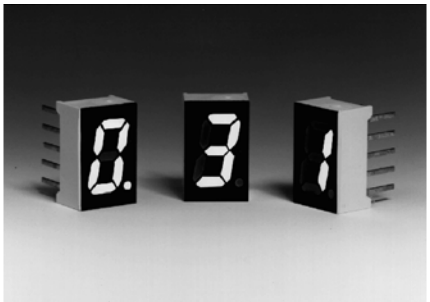
Data Sheet

HDSP-Uxxx Series
HDSP-U1xx/U2xx/U3xx/U4xx/U5xx Series
8-mm (0.31-inch) Ultra Mini Seven-Segment Displays



Description

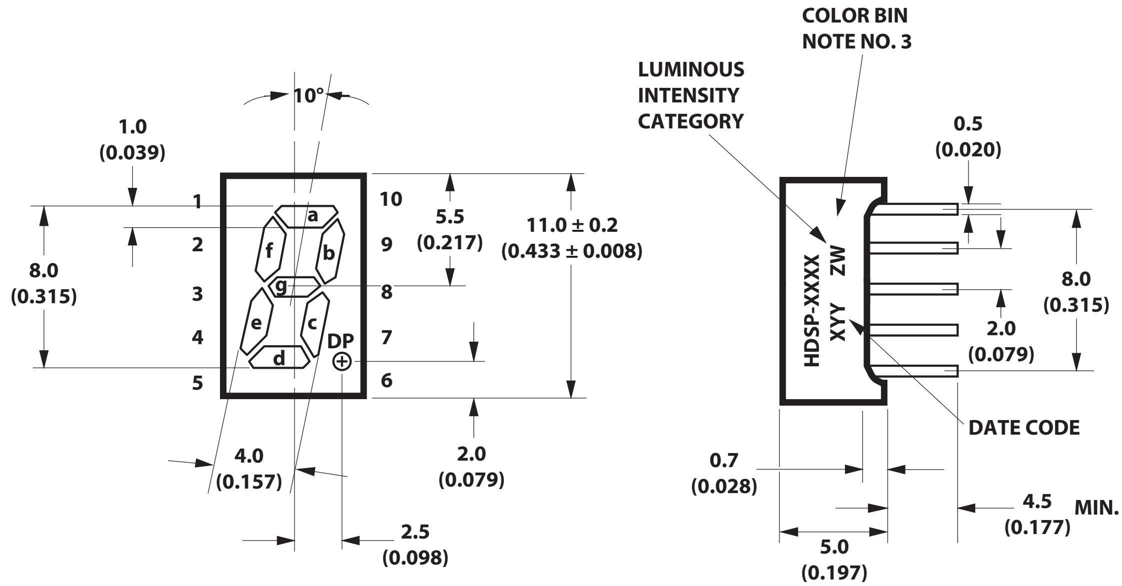
These Broadcom® 8-mm (0.31-inch) LED seven-segment displays are the company's most space-efficient character size. They are designed for viewing distances up to 3 meters (10 feet). The numeric devices feature a righthand decimal point. All devices are available as either common anode or common cathode.

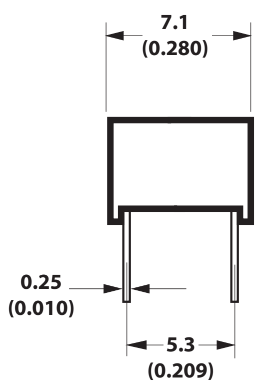
Typical applications include appliances, temperature controllers, and digital panel meters.

Features

- Compact package
- 8-mm (0.31-inch) character height
- Choice of colors: AlInGaP Deep Red, AlInGaP Red, AlInGaP Yellow, AlInGaP Green, and GaP Orange
- Excellent appearance
  - Evenly lighted segments
  - Mitered corners on segments
  - Gray/black surface gives optimum contrast
  - ±50° viewing angle
- Design flexibility
  - Common anode or common cathode
  - Righthand decimal point
- Categorized for luminous intensity
  - Yellow and green categorized for color
  - Use of like categories yields a uniform display

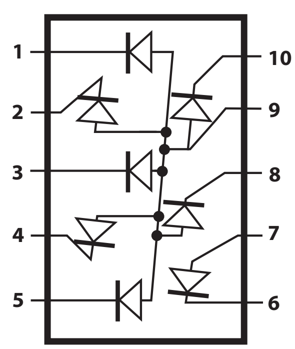
Package Drawing



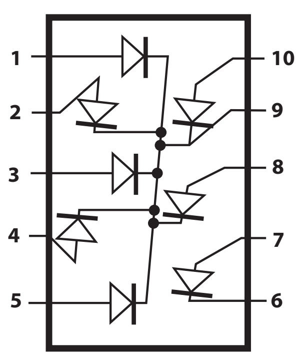


NOTES:
1. ALL DIMENSIONS IN MILLIMETERS (INCHES).
2. ALL UNTOLERANCED DIMENSIONS ARE FOR REFERENCE ONLY.
3. FOR YELLOW AND GREEN SERIES PRODUCT ONLY.

Internal Circuit Diagram



A



B

PIN	FUNCTION	
	A	B
1	CATHODE a	ANODE a
2	CATHODE f	ANODE f
3	CATHODE g	ANODE g
4	CATHODE e	ANODE e
5	CATHODE d	ANODE d
6	CATHODE DP	CATHODE DP
7	ANODE DP	ANODE DP
8	CATHODE c	ANODE c
9	ANODE	CATHODE
10	CATHODE b	ANODE b

HDSP-UOXX circuit

Device Selection Guide

AlInGaP Deep Red HDSP-	AlInGaP Red HDSP-	GaP Orange HDSP-	AlInGaP Yellow HDSP-	AlInGaP Green HDSP-	Description	Pkg Drawing
U101	U201	U401	U301	U501	Common Anode, Right Hand Decimal, Gray Surface	A
U103	U203	U403	U303	U503	Common Cathode, Right Hand Decimal, Gray Surface	B
U111	U211	U411	U311	U511	Common Anode, Right Hand Decimal, Black Surface	A
U113	U213	U413	U313	U513	Common Cathode, Right Hand Decimal, Black Surface	B

Absolute Maximum Ratings

Parameter	Deep Red HDSP-U1xx Series	Red/Orange HDSP-U2xx/-4xx Series	Yellow HDSP-U3xx Series	Green HDSP-U5xx Series	Unit
Power Dissipation per Segment or DP	37.5	75	50	75	mW
Peak Forward Current per Segment or DP[a]	90	90	60	90	mA
DC Forward Current per Segment or DP[b]	15	30	20	30	mA
Operating Temperature Range	–20 to +90				°C
Storage Temperature Range	–30 to +90				°C
Reverse Voltage per Segment or DP[c]	3.0				V
Wave Soldering Temperature for 3s (1.60 mm [0.063 in.] below body)	250				°C

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

b. Derate linearly as shown in Figure 4 (Deep Red), Figure 8 (Red), and Figure 12 (Orange), Figure 16 (Yellow), and Figure 20 (Green).

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

Electrical/Optical Characteristics (T_A = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Deep Red, Device Series HDSP-U1xx						
Luminous Intensity/Segment (Digital Average)[a, b]	I_V	0.315	1.00	—	mcd	I_F = 1 mA
Forward Voltage/Segment or DP[c]	V_F	—	2.1	2.5	V	I_F = 20 mA
Peak Wavelength	λ_p	—	656	—	nm	
Dominant Wavelength[d]	λ_d	—	639	—	nm	
Reverse Voltage/Segment or DP[e]	V_R	3.0	—	—	V	I_R = 100 µA
Red, Device Series HDSP-U2xx						
Luminous Intensity/Segment (Digital Average)[a, b]	I_V	0.77	5.2	—	mcd	I_F = 5 mA
Forward Voltage/Segment or DP[c]	V_F	—	2.05	2.5	V	I_F = 20 mA
Peak Wavelength	λ_p	—	631	—	nm	
Dominant Wavelength[d]	λ_d	—	622	—	nm	
Reverse Voltage/Segment or DP[e]	V_R	3.0	—	—	V	I_R = 100 µA
Orange, Device Series HDSP-U4xx						
Luminous Intensity/Segment (Digital Average)[a, b]	I_V	0.36	0.98	—	mcd	I_F = 5 mA
		—	5.39	—		I_F = 20 mA
Forward Voltage/Segment or DP[c]	V_F	—	2.0	2.5	V	I_F = 20 mA
Peak Wavelength	λ_p	—	600	—	nm	
Dominant Wavelength[d]	λ_d	—	603	—	nm	
Reverse Voltage/Segment or DP[e]	V_R	3.0	30	—	V	I_R = 100 µA
Yellow, Device Series HDSP-U3xx						
Luminous Intensity/Segment (Digital Average)[a, b]	I_V	0.47	2.50	—	mcd	I_F = 5 mA
Forward Voltage/Segment or DP[c]	V_F	—	2.0	2.5	V	I_F = 20 mA
Peak Wavelength	λ_p	—	591	—	nm	
Dominant Wavelength[d]	λ_d	581.5	588	592.5	nm	
Reverse Voltage/Segment or DP[e]	V_R	3.0	—	—	V	I_R = 100 µA
Green, Device Series HDSP-U5xx						
Luminous Intensity/Segment (Digital Average)[a, b]	I_V	1.94	11.0	—	mcd	I_F = 10 mA
Forward Voltage/Segment or DP[c]	V_F	—	2.1	2.5	V	I_F = 10 mA
Peak Wavelength	λ_p	—	572	—	nm	
Dominant Wavelength[d]	λ_d	—	571	—	nm	
Reverse Voltage/Segment or DP[e]	V_R	3.0	—	—	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. Forward voltage tolerance is ±0.1V.

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

e. Typical specification for reference only. Do not exceed absolute maximum ratings, and long-term reverse bias is not recommended.

Part Numbering System

5082 - x xx x - x x x xx
HDSP - x xx x - x x x xx

Mechanical Options [1]
00: No mechanical option
36: Special dimensional tolerances

Color Bin Options [1,2]
0: No color bin limitation

Maximum Intensity Bin [1,2]
0: No maximum intensity bin limitation

Minimum Intensity Bin [1,2]
0: No minimum intensity bin limitation

Device Configuration/Color [1]
1: Common Anode
3: Common Cathode

Device Specific Configuration [1]
Refer to respective data sheet

Package [1]
U: 8-mm (0.31-inch) Ultra Mini Single-Digit Seven-Segment Display

1. For codes not listed in the figure, refer to the respective data sheet or contact your nearest Broadcom representative for details.
2. Bin options refer to shippable bins for a part number. Color and Intensity Bins are typically restricted to 1 bin per tube (exceptions may apply). Refer to respective data sheet for specific bin limit information.

Intensity Bin Limits (mcd)

Deep Red, HDSP-U1xx

IV Bin Category	Min.	Max.
E	0.315	0.520
F	0.428	0.759
G	0.621	1.16
H	0.945	1.71
I	1.40	2.56
J	2.10	3.84
K	3.14	5.75
L	4.70	8.55

Red, HDSP-U2xx

IV Bin Category	Min.	Max.
D	0.774	1.418
E	1.160	2.127
F	1.740	3.190
G	2.610	4.785
H	3.915	7.177
I	5.873	10.758
J	8.802	16.118

Orange, HDSP-U4xx

IV Bin Category	Min.	Max.
C	0.443	0.677
D	0.554	0.846
E	0.692	1.057
F	0.856	1.322
G	1.082	1.652
H	1.352	2.066
I	1.692	2.581
J	2.114	3.227
K	2.641	4.034
L	3.300	5.042
M	4.127	6.303
N	5.157	7.878

Yellow, HDSP-U3xx

IV Bin Category	Min.	Max.
D	0.476	0.872
E	0.714	1.311
F	1.073	1.967
G	1.609	2.950
H	2.413	4.425
I	3.621	6.639
J	5.432	9.958

Green, HDSP-U5xx

IV Bin Category	Min.	Max.
J	1.94	3.55
K	2.90	5.33
L	4.37	8.01
M	6.55	12.01
N	9.83	18.02
O	14.74	27.03

Color Categories

Color	Bin	Dominant Wavelength (nm)	
		Min.	Max.
Yellow	1	581.50	585.00
	3	584.00	587.50
	2	586.50	590.00
	4	589.00	592.50
Green	2	573.00	577.00
	3	570.00	574.00
	4	567.00	571.00
	5	564.00	568.00

NOTE: All categories are established for classification of products. Products may not be available in all categories. Contact your Broadcom representatives for further clarification or information.

Deep Red Graphs

Figure 1: Relative Intensity vs. Wavelength

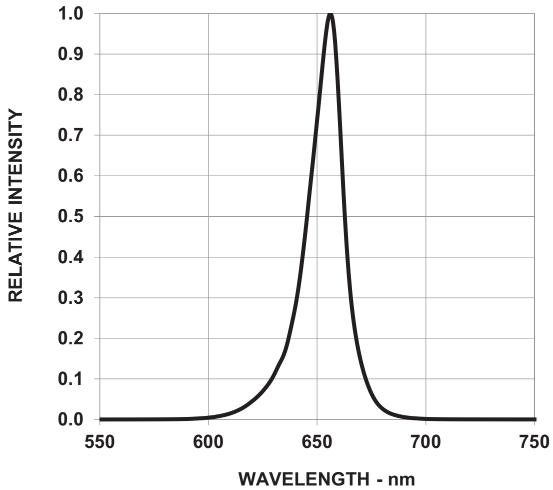


Figure 2: Forward Current vs. Forward Voltage

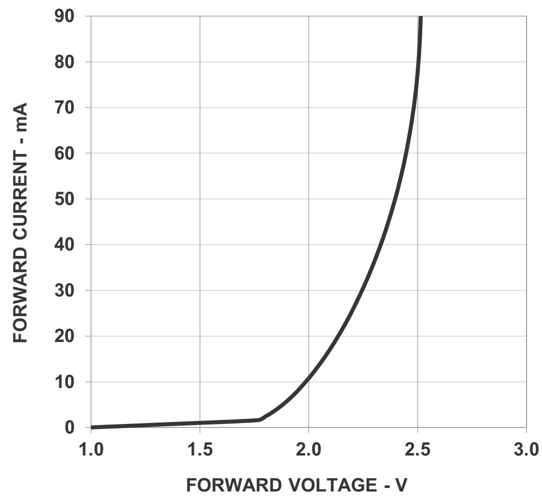


Figure 3: Relative Luminous Intensity vs. Forward Current

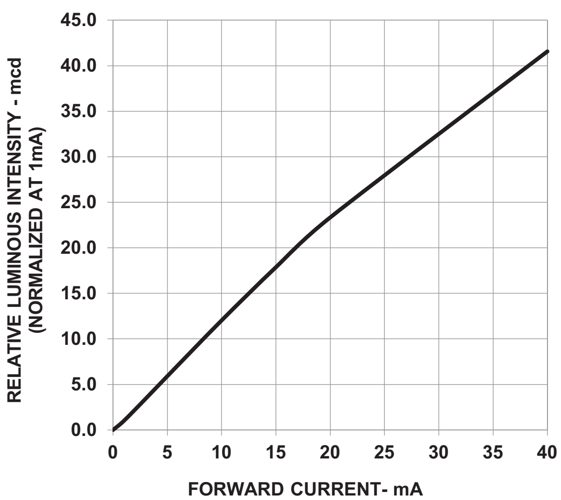
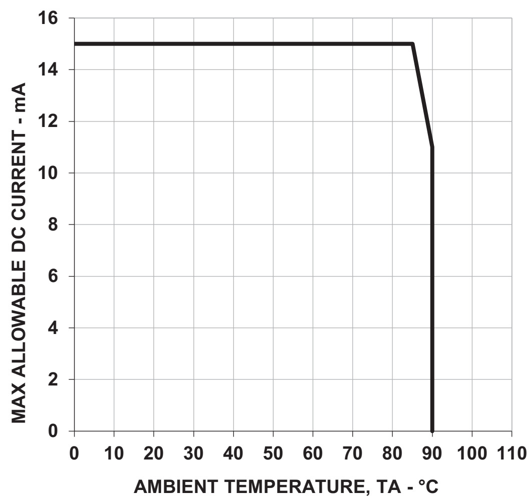


Figure 4: Maximum Forward Current vs. Ambient Temperature



Red Graphs

Figure 5: Relative Intensity vs. Wavelength

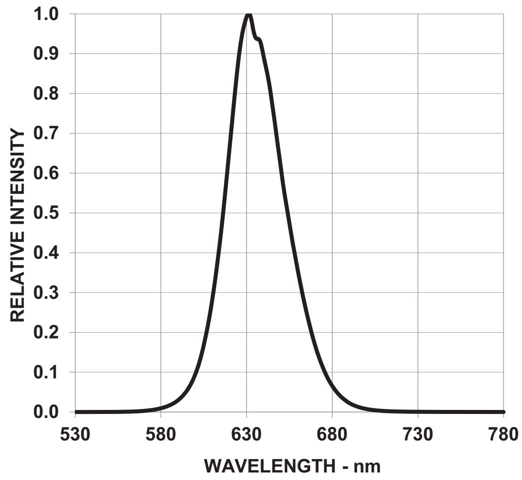


Figure 6: Forward Current vs. Forward Voltage

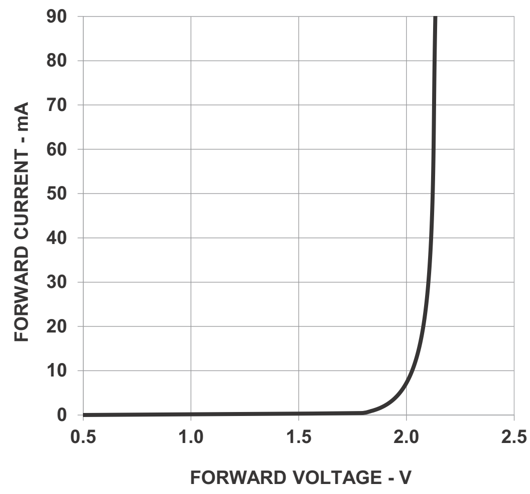


Figure 7: Relative Luminous Intensity vs. Forward Current

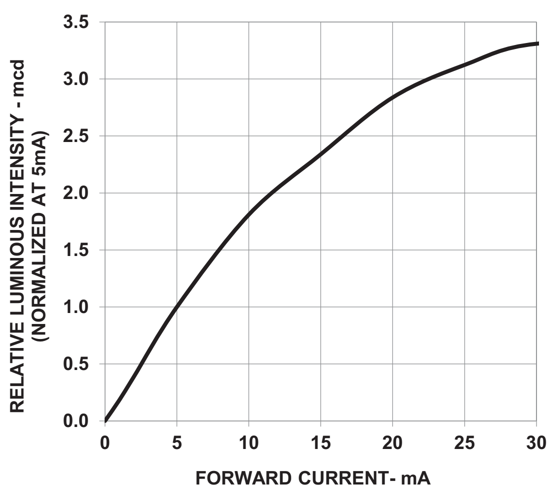
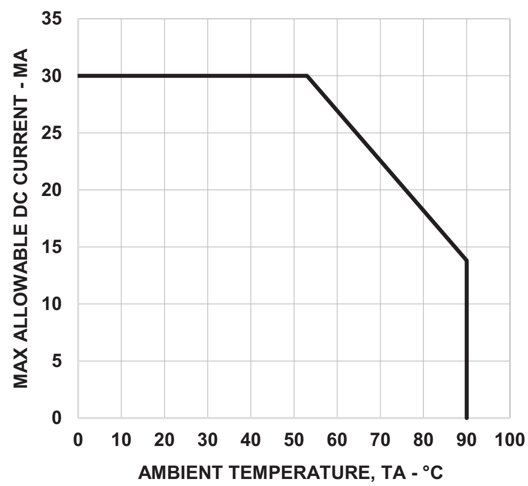


Figure 8: Maximum Forward Current vs. Ambient Temperature



Orange Graphs

Figure 9: Relative Intensity vs. Wavelength

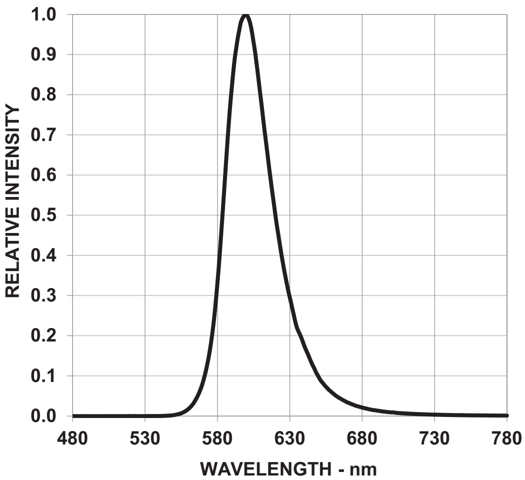


Figure 10: Forward Current vs. Forward Voltage

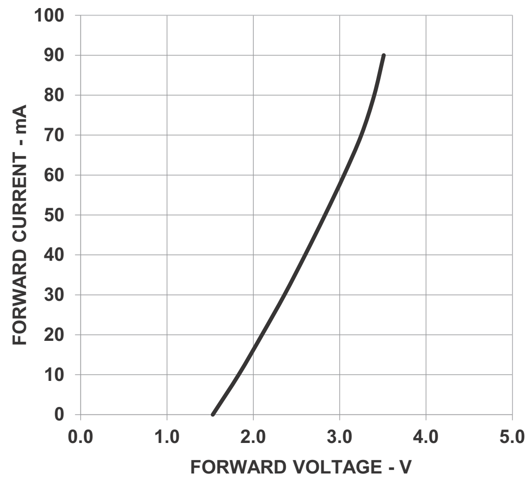


Figure 11: Relative Luminous Intensity vs. Forward Current

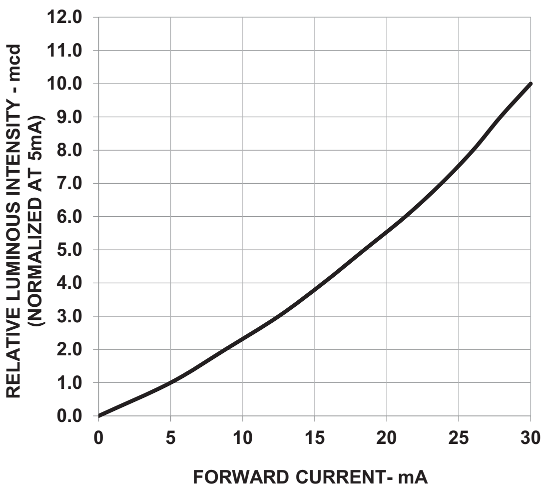
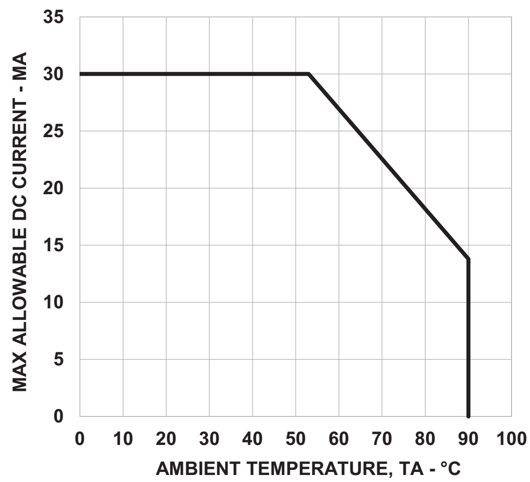


Figure 12: Maximum Forward Current vs. Ambient Temperature



Yellow Graphs

Figure 13: Relative Intensity vs. Wavelength

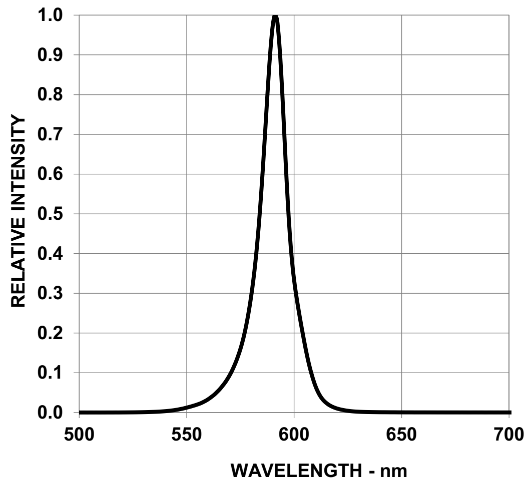


Figure 14: Forward Current vs. Forward Voltage

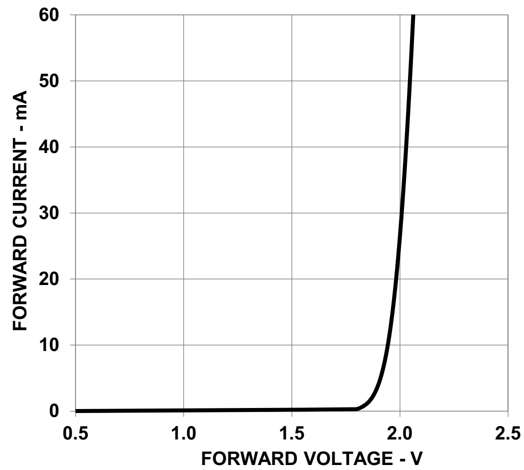


Figure 15: Relative Luminous Intensity vs. Forward Current

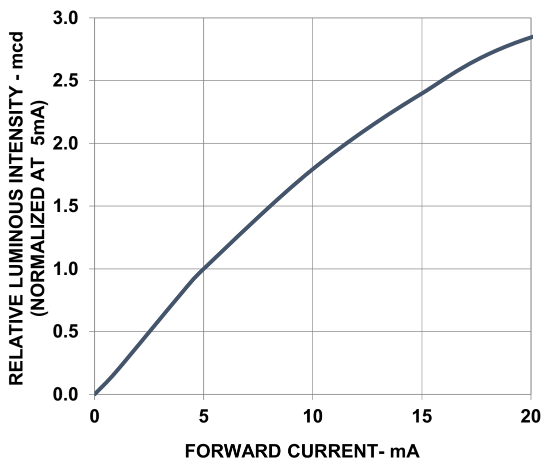
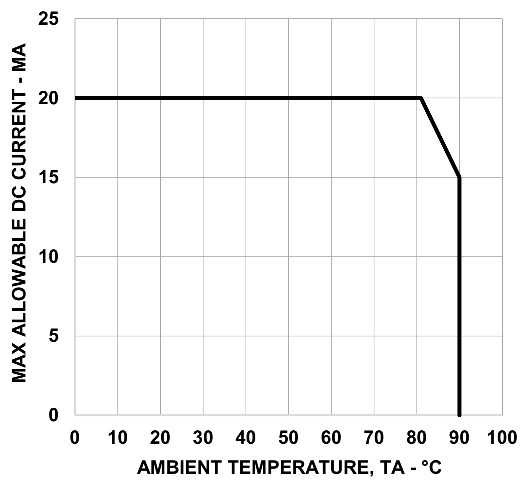


Figure 16: Maximum Forward Current vs. Ambient Temperature



Green Graphs

Figure 17: Relative Intensity vs. Wavelength

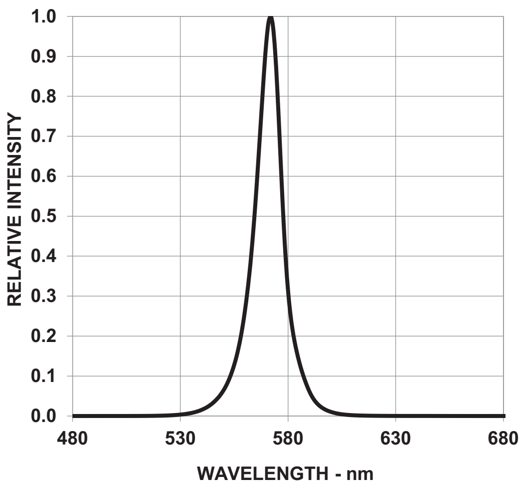


Figure 18: Forward Current vs. Forward Voltage

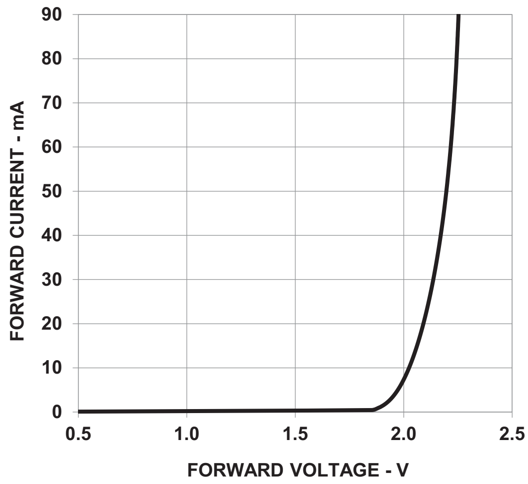


Figure 19: Relative Luminous Intensity vs. Forward Current

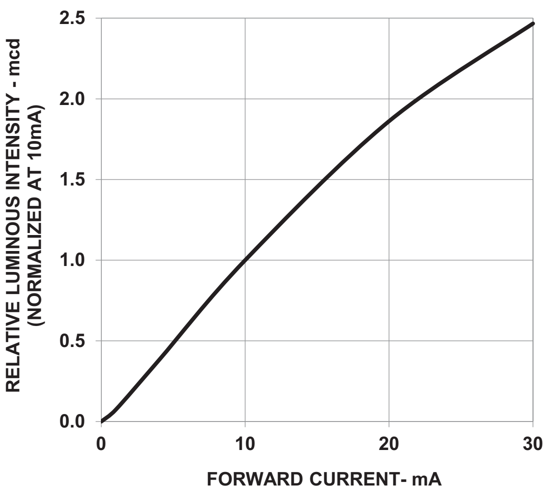
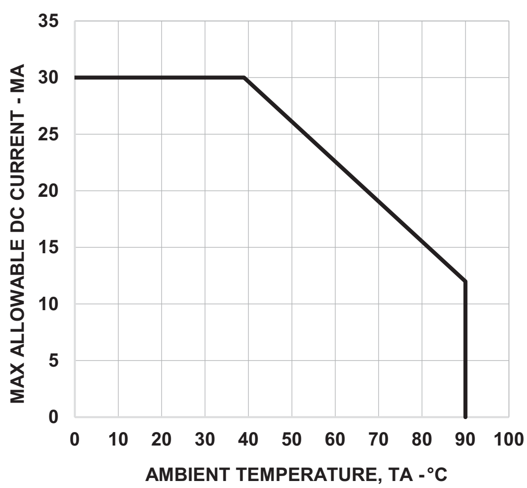


Figure 20: Maximum Forward Current vs. Ambient Temperature

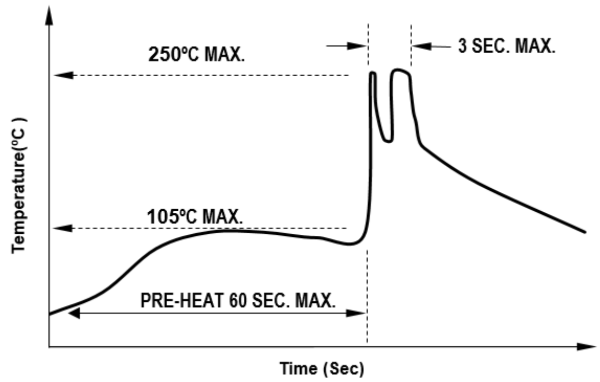


Precautionary Notes

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 a 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 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 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 21: Recommended Wave Soldering Profile



NOTE: Figure 21 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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