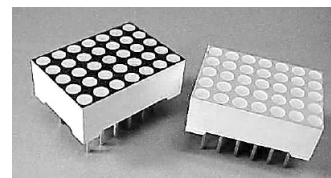


# HDSP-701x, HDSP-703x, HDSP-711x, and HDSP-713x Series

## 17.3-mm (0.68-inch) General-Purpose 5x7 Dot Matrix Alphanumeric Displays



### Description

The Broadcom® HDSP-701x, HDSP-703x, HDSP-711x, and HDSP-713x Series displays have a 17.3-mm (0.68-inch) character height and use industry-standard size and pinout. The devices are available in either common row anode or common row cathode configurations. The displays come in either gray or black face paint and are available in a choice of GaP high efficiency red (HER), GaP green, or AllnGaP deep red.

### Applications

- Suitable for indoor use
- Not recommended for industrial application, i.e., operating temperature requirements exceeding +85°C or below –40°C<sup>1</sup>
- Extreme temperature cycling not recommended

### Features

- 5 × 7 dot matrix font
- Viewable up to 12 meters
- X-Y stackable
- Industry-standard pinout
  - 7.6-mm (0.3 in.) Dual-in-Line (DIP) leads on 2.54 mm (0.1 in.) centers
- Choice of colors
  - GaP high efficiency red (HER), GaP green, AllnGaP deep red
- Choice of face paint colors
  - Gray or black
- Design flexibility
  - Common row anode or common row cathode
- Categorized for luminous intensity
- Green categorized for color

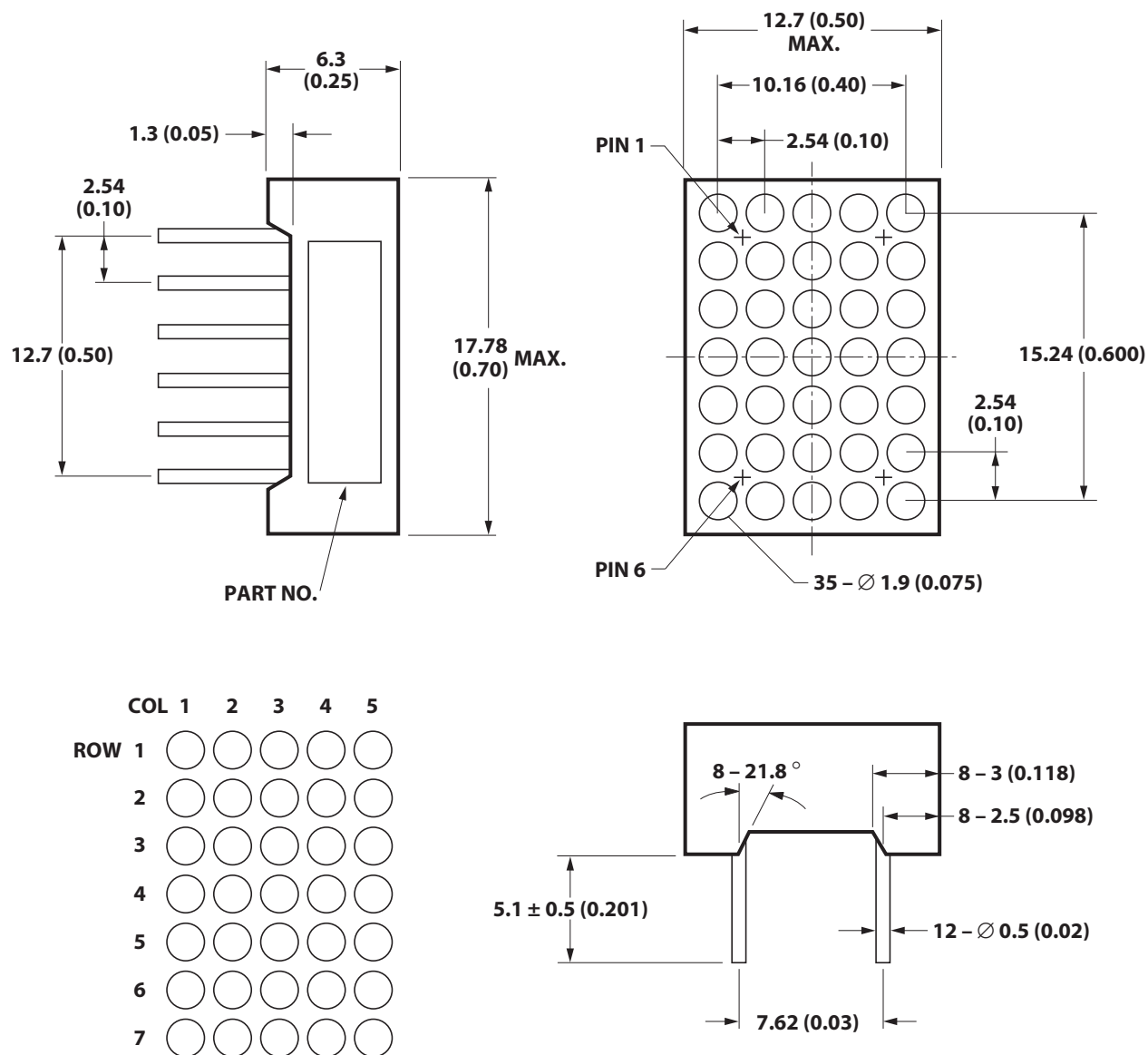
### Ordering Information

GaP HER	GaP Green	AllnGaP Deep Red	Description
HDSP-701E	HDSP-701G	HDSP-701A	17.3 mm Gray Surface Common Row Anode
HDSP-703E	HDSP-703G	HDSP-703A	17.3 mm Gray Surface Common Row Cathode
HDSP-711E	HDSP-711G	HDSP-711A	17.3 mm Black Surface Common Row Anode
HDSP-713E	HDSP-713G	HDSP-713A	17.3 mm Black Surface Common Row Cathode

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

# Package Dimensions

Figure 1: Package Drawing

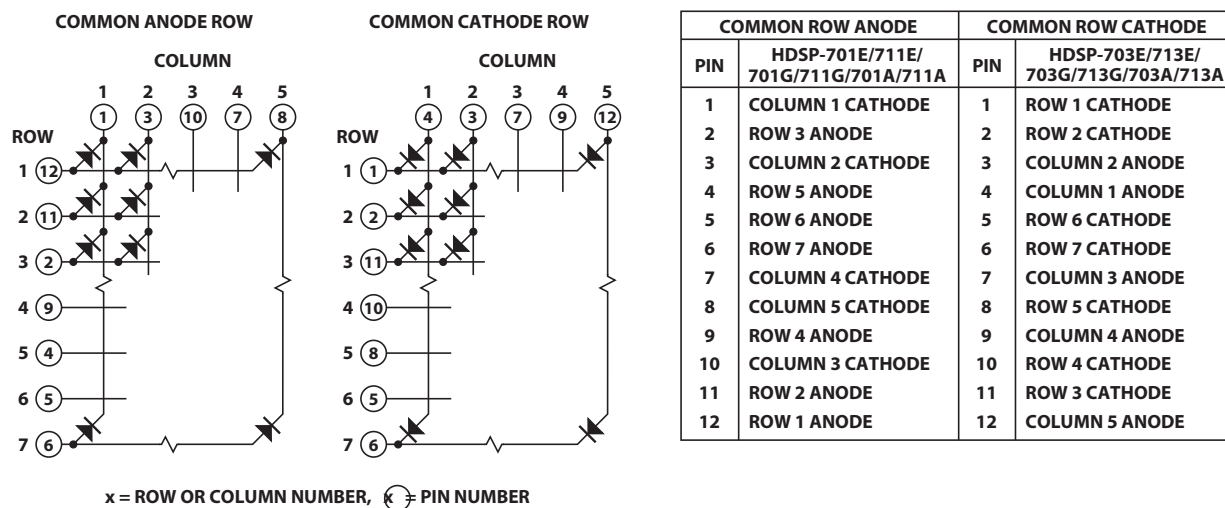


## NOTES:

1. ALL DIMENSIONS IN MILLIMETERS (INCHES).
2. UNLESS OTHERWISE STATED, TOLERANCE IS  $\pm 0.25$  mm (0.010).
3. FOR GREEN ONLY.

## Internal Circuit Diagram

Figure 2: Common Anode and Cathode Rows



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

Description	HER HDSP-701E/ 711E/703E/ 713E	Deep Red HDSP-701A/ 703A/711A/ 713A	Green HDSP-701G/ 711G/703G/ 713G	Unit
Average Power per Dot	75	52	75	mW
Peak Forward Current per Dot	90 <sup>a</sup>	60 <sup>b</sup>	90 <sup>a</sup>	mA
Average Forward Current per Dot	23 <sup>c</sup>	20 <sup>d</sup>	15 <sup>c</sup>	mA
Reverse Voltage per Dot	Not designed for reverse bias operation			V
Operating Temperature	-40 to +85	-40 to +85	-40 to +85	°C
Storage Temperature	-40 to +85	-40 to +85	-40 to +85	°C
Wave Soldering Temperature for 3 Seconds <sup>e</sup> (1.6-mm [0.063 in.] below body)	250	250	250	°C

a. 1/10 Duty Cycle, 0.1-ms Pulse Width.

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

c. Derate linearly as shown in [Figure 3](#).

d. Derate linearly as shown in [Figure 10](#).

e. Not recommended to be soldered more than 2 times. Minimum interval between solderings is 15 minutes. Total soldering time not to exceed 5 seconds.

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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
<b>High Efficiency Red (HER) Devices HDSP-701E/711E/703E/713E</b>						
Luminous Intensity/Dot <sup>a,b,c</sup> (Digital Average)	$I_V$	1.289	2.500	—	mcd	$I_F = 50 \text{ mA}$ , 20% duty factor
Peak Wavelength	$\lambda_P$	—	632	—	nm	$I_F = 20 \text{ mA}$
Dominant Wavelength <sup>d</sup>	$\lambda_d$	—	622	—	nm	$I_F = 20 \text{ mA}$
Forward Voltage <sup>e</sup>	$V_F$	—	—	3.4	V	$I_F = 50 \text{ mA}$
		—	2.05	2.5		$I_F = 20 \text{ mA}$
		1.60	—	—		$I_F = 5 \text{ mA}$
Reverse Voltage <sup>f</sup>	$V_R$	5	—	—	V	$I_R = 100 \text{ mA}$
Luminous Intensity Matching Ratio	$I_{V-M}$	—	—	2:1		$I_F = 50 \text{ mA}$ , 20% duty factor
<b>Green Devices HDSP-701G/711G/703G/713G</b>						
Luminous Intensity/Dot <sup>a,b,c</sup> (Digital Average)	$I_V$	0.96	2.50	—	mcd	$I_F = 50 \text{ mA}$ , 20% duty factor
Peak Wavelength	$\lambda_P$	—	568	—	nm	$I_F = 20 \text{ mA}$
Dominant Wavelength <sup>d</sup>	$\lambda_d$	—	573	—	nm	$I_F = 20 \text{ mA}$
Forward Voltage <sup>e</sup>	$V_F$	—	—	3.4	V	$I_F = 50 \text{ mA}$
		1.80	2.25	2.6		$I_F = 20 \text{ mA}$
		1.60	—	—		$I_F = 5 \text{ mA}$
Reverse Voltage <sup>f</sup>	$V_R$	5	—	—	V	$I_R = 100 \text{ mA}$
Luminous Intensity Matching Ratio	$I_{V-M}$	—	—	2:1		$I_F = 50 \text{ mA}$ , 20% duty factor
<b>Deep Red Devices HDSP-701A/711A/703A/713A</b>						
Luminous Intensity/Dot <sup>a,b,c</sup> (Digital Average)	$I_V$	1.55	2.10	—	mcd	$I_F = 10 \text{ mA}$ , 20% duty factor
Peak Wavelength	$\lambda_P$	—	660	—	nm	$I_F = 20 \text{ mA}$
Dominant Wavelength <sup>d</sup>	$\lambda_d$	—	640	—	nm	$I_F = 20 \text{ mA}$
Forward Voltage <sup>e</sup>	$V_F$	—	2	2.6	V	$I_F = 20 \text{ mA}$
		—	—	2.6		$I_F = 10 \text{ mA}$
		1.5	—	—		$I_F = 5 \text{ mA}$
Reverse Voltage <sup>f</sup>	$V_R$	5	—	—	V	$I_R = 100 \text{ mA}$
Luminous Intensity Matching Ratio	$I_{V-M}$	—	—	2:1		$I_F = 10 \text{ mA}$ , 20% duty factor

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. The dominant wavelength,  $\lambda_d$ , is derived from the CIE Chromaticity Diagram and represents the perceived color of the device.

e. Forward voltage tolerance is  $\pm 0.1\text{V}$ .

f. Indicates product final test condition. Long-term reverse bias is not recommended.

# Green/High Efficiency Red (HER)

Figure 3: Maximum Allowable Average Current Per Dot vs. Ambient Temperature

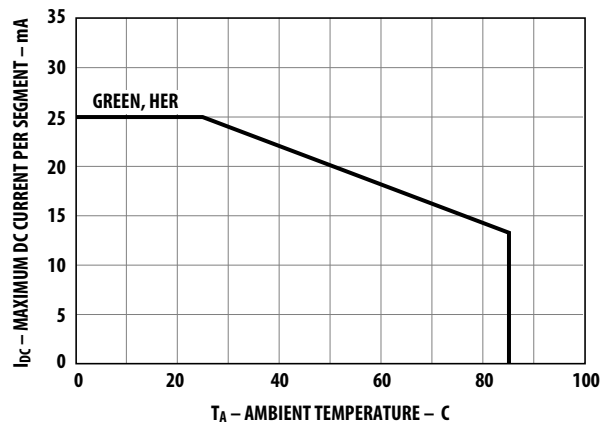


Figure 4: Forward Current vs. Forward Voltage

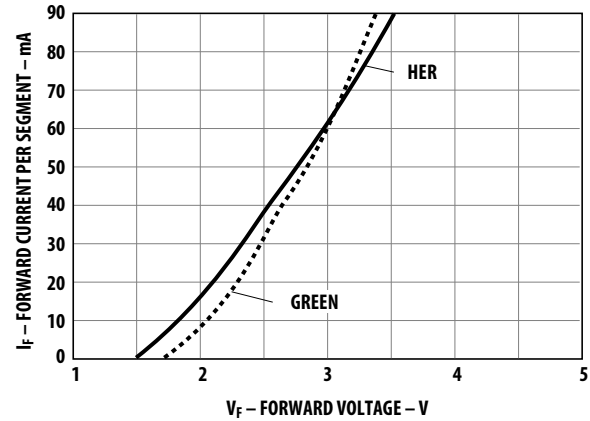


Figure 5: Relative Luminous Intensity vs. DC Forward Current

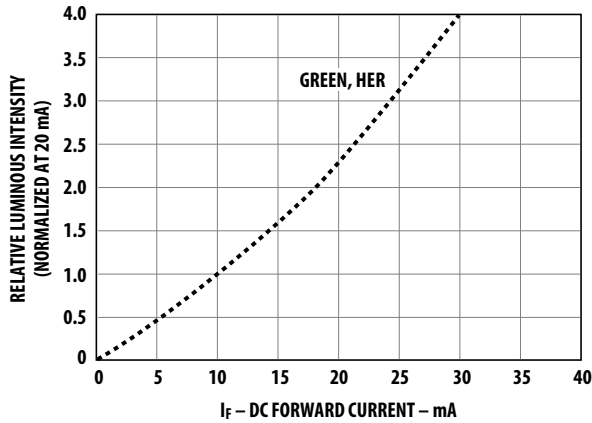
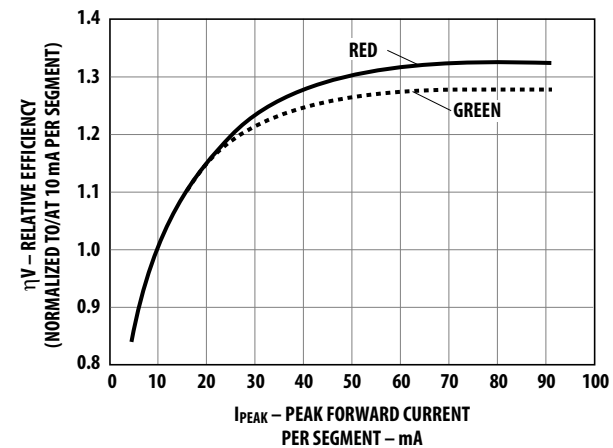


Figure 6: Relative Efficiency (Luminous Intensity Per Unit Current Per Dot) vs. Peak Current Per Dot



# Deep Red Graphs

Figure 7: Spectral Power Distribution

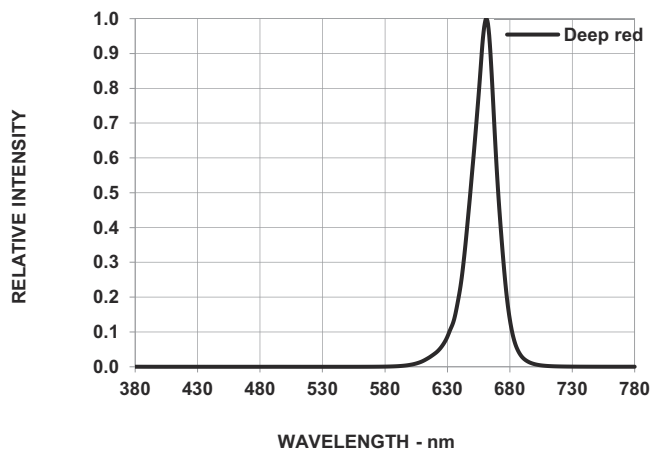


Figure 8: Forward Current vs. Forward Voltage

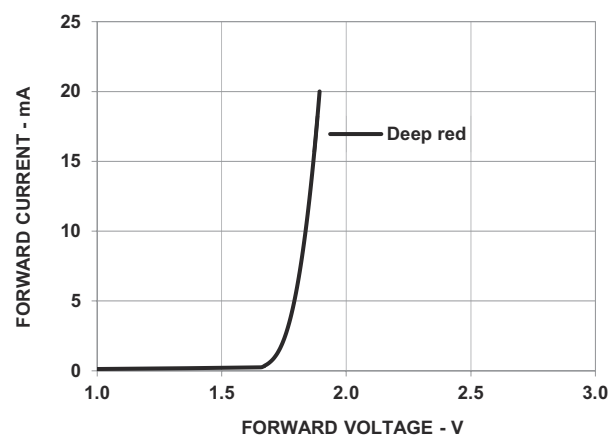


Figure 9: Relative Luminous Intensity vs. Forward Current

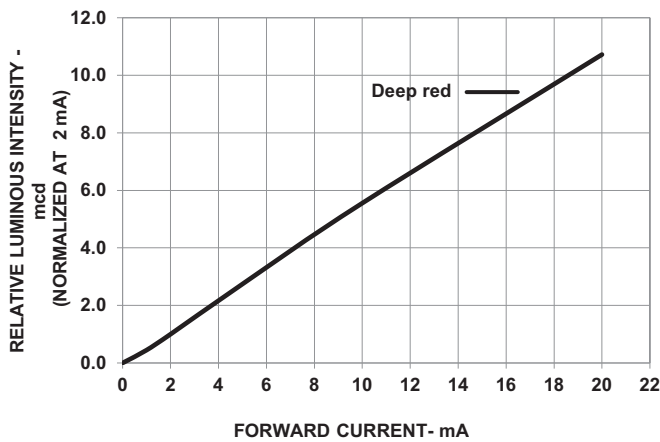
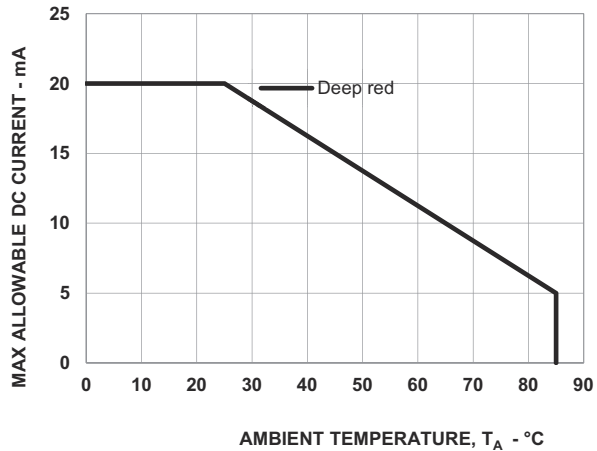


Figure 10: Maximum Forward Current vs. Ambient Temperature



## Intensity Bin Limits<sup>2</sup> (mcd at 50 mA, 20% Duty Factor)

### High Efficiency Red

Bin Name	High Efficiency Red (HER)	
	Min.	Max.
E	1.289	1.934
F	1.934	2.900
G	2.900	4.350
H	4.350	6.525

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

### Green

Bin Name	Green	
	Min.	Max.
H	0.96	1.44
I	1.44	2.15
J	2.15	3.23
K	3.23	4.85
L	4.85	7.28

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

## Intensity Bin Limits<sup>2</sup> (mcd at 10 mA, 20% Duty Factor)

### Deep Red

Bin Name	Deep Red	
	Min.	Max.
I	1.55	2.33
J	2.33	3.49

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

## Color Bin Limits<sup>2</sup> (Dominant Wavelength)

Color	Bin	Dominant Wavelength (nm)	
		Min.	Max.
Green	2	573.6	576.5
	3	570.6	573.5
	4	567.6	570.5
	5	564.5	567.5

2. Bin categories are established for classification of products. Products might not be available in all bin categories.

## Precautionary Notes

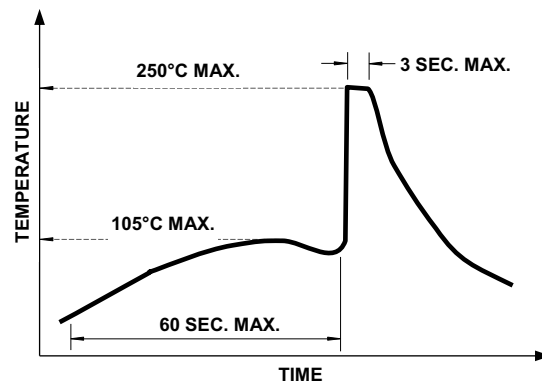
### Soldering and Handling Precautions

- 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 11: Recommended Wave Soldering Profile



**NOTE:** Figure 11 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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