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BROADCOM®

Data Sheet

HSMF-C153/C155/C156/C157/C158

Bicolor Surface-Mount ChipLEDs



Description

The Broadcom® HSMF-C15x series of bicolor chip-type LEDs is an industry-standard package for ease of handling and use. These bicolor LEDs are available as high efficiency red/yellow, high efficiency red/green, yellow/green, orange/green and green/amber. The HSMF-C15x has the widely used 3.2 mm × 2.7 mm footprint and wide viewing angle that make this LED exceptional for backlighting applications.

All packages are compatible with reflow solder processes. The small size and wide viewing angle make these LEDs prime choices for backlighting applications and front panel indicators, especially where space is a premium.

Features

- Small size
- Industry-standard footprint
- Compatible with IR solder
- Diffused optics
- Operating temperature range of –40°C to +85°C
- Five color combinations available: Red/Yellow, Red/Green, Yellow/Green, Orange/Green and Green/Amber.
- Available in 8-mm tape on 178-mm (7-in.) diameter reels

Applications

- Push-button backlighting
- Symbol backlighting
- Status indicator
- Front panel indicator

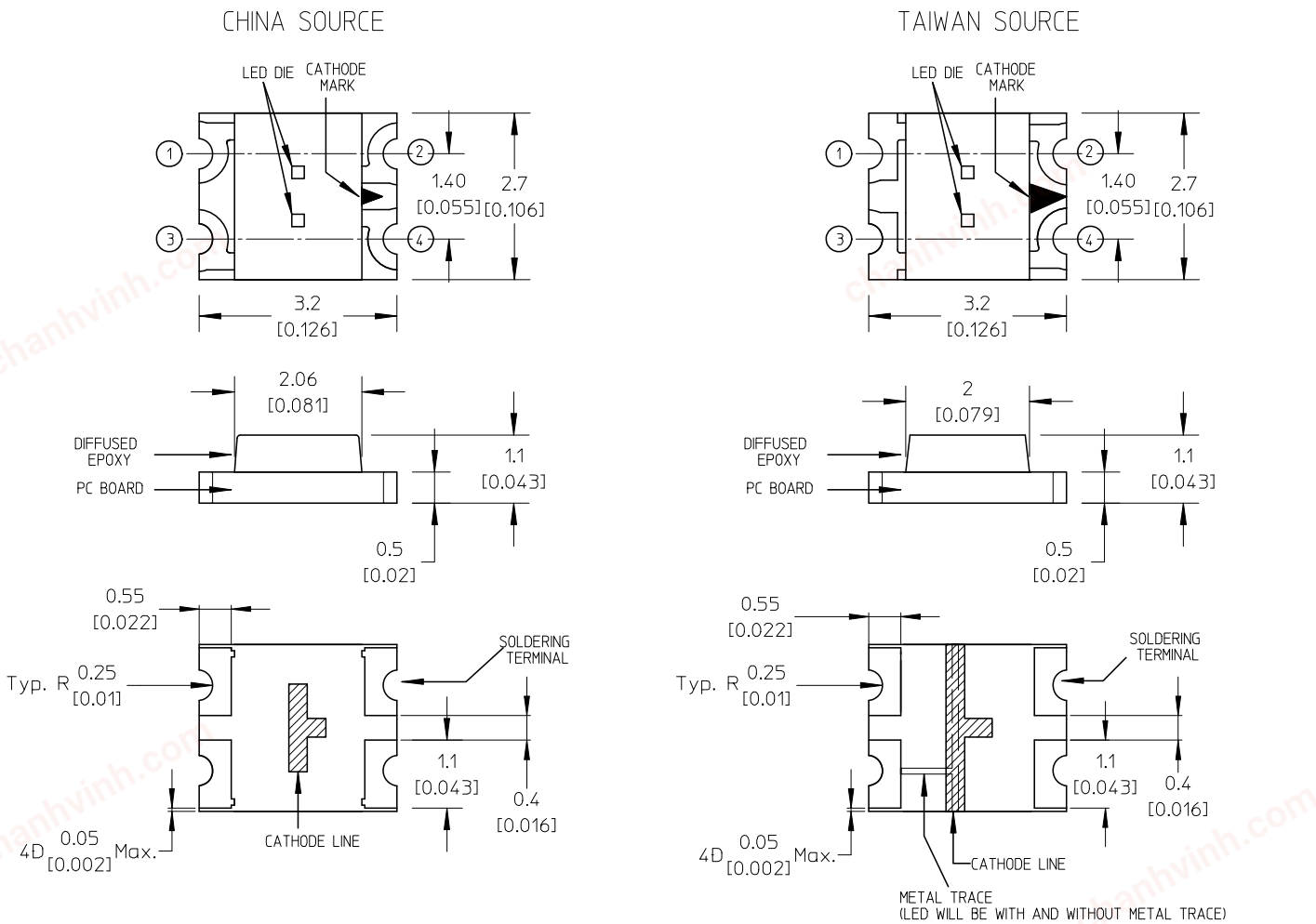
Device Selection Guide

Part Number	Parts per Reel	Color	Package Description
HSMF-C153	3000	AlInGaP Yellow/Red	Untinted, Diffused
HSMF-C155	3000	AlInGaP Red/Green	Untinted, Diffused
HSMF-C156	3000	AlInGap Yellow/Green	Untinted, Diffused
HSMF-C157	3000	AlInGaP Orange/Green	Untinted, Diffused
HSMF-C158	3000	AlInGaP Green/Amber	Untinted, Diffused

CAUTION! HSMF-C15x LEDs are Class 1A ESD sensitive per JESD22-A114C.01 standard. Observe appropriate precautions during handling and processing. Refer to Application Note AN-1142 for additional details.

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Package Dimensions



NOTES:
1. ALL DIMENSIONS IN MILLIMETERS (INCHES).
2. TOLERANCE IS ± 0.1 mm (± 0.004 IN.) UNLESS OTHERWISE SPECIFIED.

Polarity	HSMF-C153	HSMF-C155	HSMF-C156	HSMF-C157	HSMF-C158
① — ②	Yellow	Green	Green	Green	Green
③ — ④	Red	Red	Yellow	Orange	Amber

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Absolute Maximum Ratings at T_A = 25°C

Parameter	AlInGaP Red/Yellow/ Orange/Green	AlInGaP Amber	Unit
DC Forward Current[a]	20	25	mA
Power Dissipation[b]	52	60	mW
Reverse Voltage (I_R = 100 µA)	5	5	V
LED Junction Temperature	95	95	°C
Operating and Storage Temperature Range	–40 to 85		°C
Soldering Temperature	See reflow soldering profile (Figure 6 and Figure 7)		

a. Derate linearly as shown in Figure 4 for temperature above 25°C.

b. Pulse condition of 1/10 duty and 0.1 ms width

Electrical Characteristics (T_A = 25°C, I_F = 20 mA)

Part Number	Color	Forward Voltage,[a] V_F (V)			Reverse Current,[b] I_R (µA) at V_R = 5V	Thermal Resistance,[c] $R\theta_{J-S}$ (°C/W)
		Min.	Typ.	Max.	Max.	Typ.
HSMF-C153	AlInGaP Yellow	1.60	2.10	2.60	100	325
	AlInGaP Red	1.60	2.10	2.60	100	325
HSMF-C155	AlInGaP Green	1.60	2.20	2.60	100	325
	AlInGaP Red	1.60	2.10	2.60	100	325
HSMF-C156	AlInGaP Green	1.60	2.20	2.60	100	325
	AlInGaP Yellow	1.60	2.10	2.60	100	325
HSMF-C157	AlInGaP Green	1.60	2.20	2.60	100	325
	AlInGaP Orange	1.60	2.20	2.60	100	325
HSMF-C158	AlInGaP Green	1.60	2.10	2.40	100	325
	AlInGaP Amber	1.60	1.90	2.40	100	325

a. Forward voltage tolerance is ±0.1V.

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

c. Thermal resistance from LED junction to solder point.

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Optical Characteristics (T_A = 25°C, I_F = 20 mA)

Part Number	Color	Luminous Intensity, I_V [a] (mcd)		Dominant Wavelength, λ_d [b] (nm)	Peak Wavelength, λ_p (nm)	Viewing Angle $2\theta_{1/2}$ [c](Degrees)
		Min.	Typ.	Typ.	Typ.	Typ.
HSMF-C153	AInGaP Yellow	2.50	8.00	586	589	170
	AlInGaP Red	2.50	10.00	626	630	170
HSMF-C155	AlInGaP Green	4.00	15.00	572	570	170
	AlInGaP Red	2.50	10.00	626	630	170
HSMF-C156	AlInGaP Green	4.00	15.00	572	570	170
	AlInGaP Yellow	2.50	8.00	586	589	170
HSMF-C157	AlInGaP Green	4.00	15.00	572	570	170
	AlInGaP Orange	2.50	8.00	604	605	170
HSMF-C158	AlInGaP Green	28.50	45.00	572	570	170
	AlInGaP Amber	28.50	55.00	592	595	170

a. The luminous intensity, I_V, is measured at the mechanical axis of the package, and it is tested with a single current pulse condition. The actual peak of the spatial radiation pattern may not be aligned with the axis.

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

c. $\theta_{1/2}$ is the off-axis angle where the luminous intensity is one half the peak intensity.

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Color Bin Limits[1]

AlInGaP Red

Bin ID	Dominant Wavelength (nm)	
	Minimum	Maximum
—	620.0	635.0

Tolerance: ±1 nm.

AlInGaP Amber/Yellow

Bin ID	Dominant Wavelength (nm)	
	Minimum	Maximum
A	582.0	584.5
B	584.5	587.0
C	587.0	589.5
D	589.5	592.0
E	592.0	594.5
F	594.5	597.0

Tolerance: ±1 nm.

AlInGaP Orange

Bin ID	Dominant Wavelength (nm)	
	Minimum	Maximum
A	597.0	600.0
B	600.0	603.0
C	603.0	606.0
D	606.0	609.0
E	609.0	612.0
F	612.0	615.0

Tolerance: ±1 nm.

AlInGaP Green

Bin ID	Dominant Wavelength (nm)	
	Minimum	Maximum
A	561.5	564.5
B	564.5	567.5
C	567.5	570.5
D	570.5	573.5
E	573.5	576.5

Tolerance: ±1 nm.

Light Intensity (I_V) Bin Limits

Bin ID	Intensity (mcd)	
	Minimum	Maximum
A	0.11	0.18
B	0.18	0.29
C	0.29	0.45
D	0.45	0.72
E	0.72	1.10
F	1.10	1.80
G	1.80	2.80
H	2.80	4.50
J	4.50	7.20
K	7.20	11.20
L	11.20	18.00
M	18.00	28.50
N	28.50	45.00
P	45.00	71.50
Q	71.50	112.50
R	112.50	180.00
S	180.00	285.00
T	285.00	450.00
U	450.00	715.00
V	715.00	1125.00
W	1125.00	1800.00
X	1800.00	2850.00
Y	2850.00	4500.00

Tolerance: ±15%.

1. Bin categories are established for classification of products. Products may not be available in all categories. Contact your Broadcom representative for information on current available bins.

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Figure 1: Relative Intensity vs. Wavelength

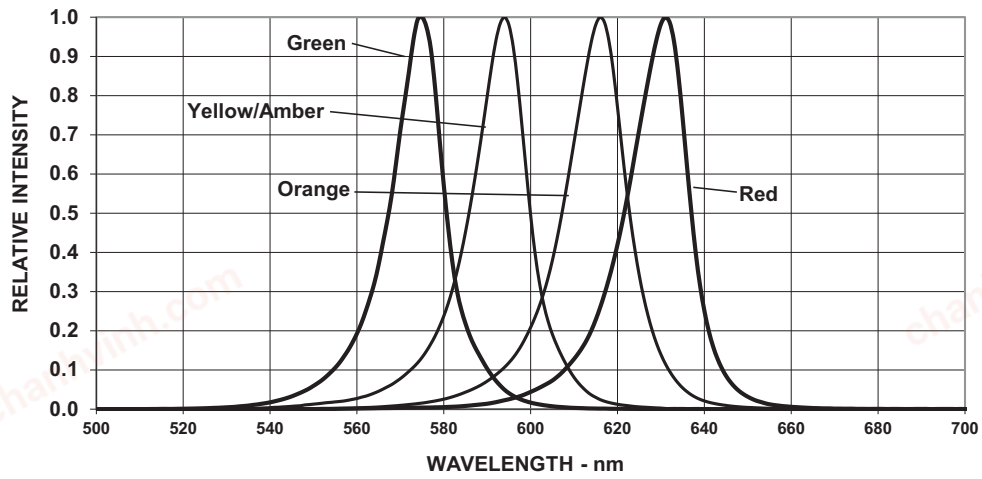


Figure 2: Forward Current vs. Forward Voltage

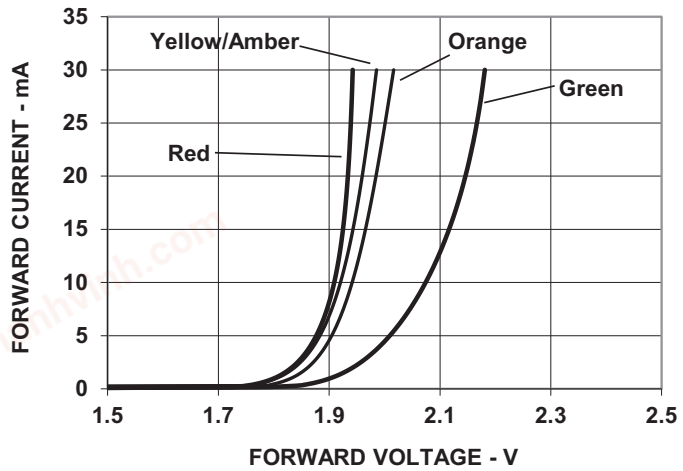


Figure 3: Luminous Intensity vs. Forward Current

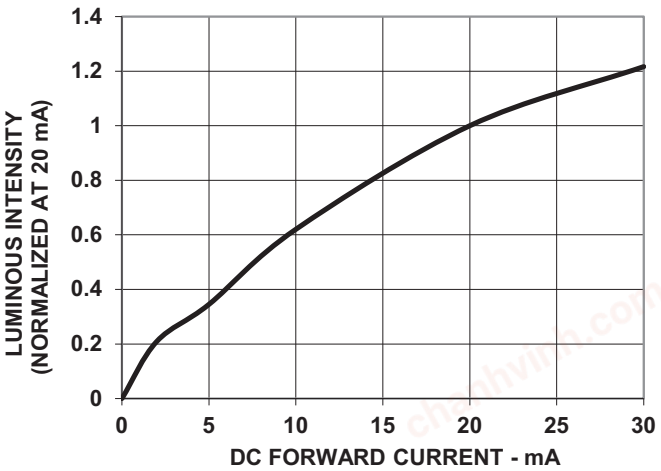
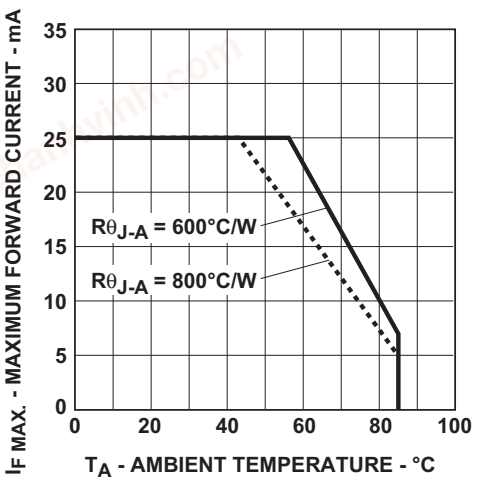


Figure 4: Maximum Forward Current vs. Ambient Temperature



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Figure 5: Relative Intensity vs. Angle for HSMF-C153, C155, C156, C157, and C158

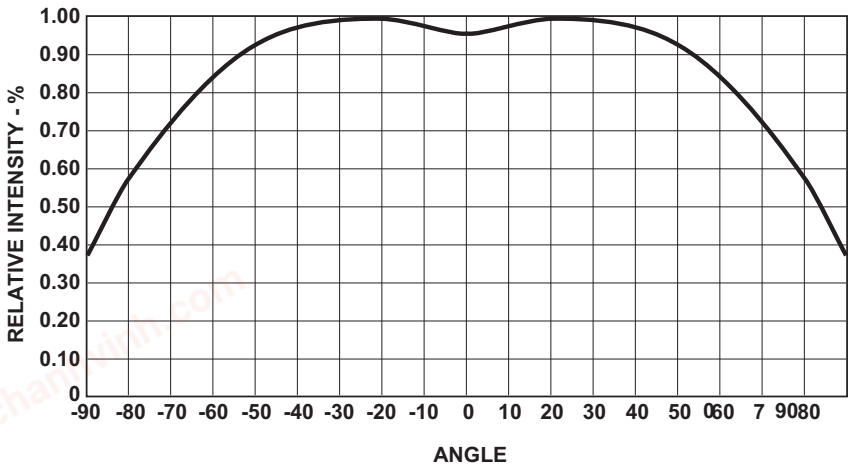


Figure 6: Recommended Reflow Soldering Profile

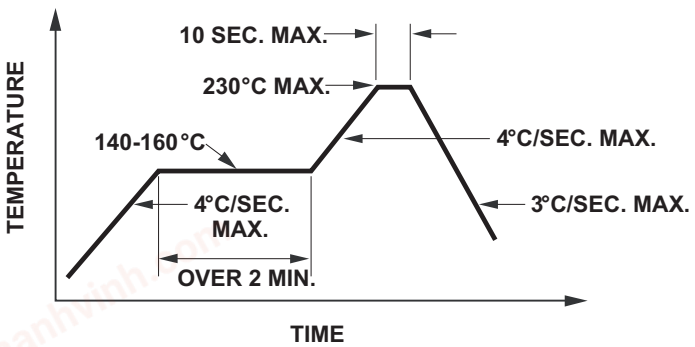


Figure 7: Recommended Pb-free Reflow Soldering Profile

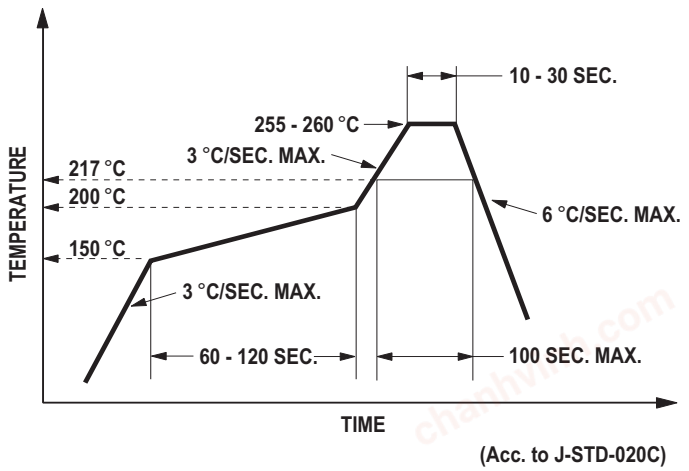
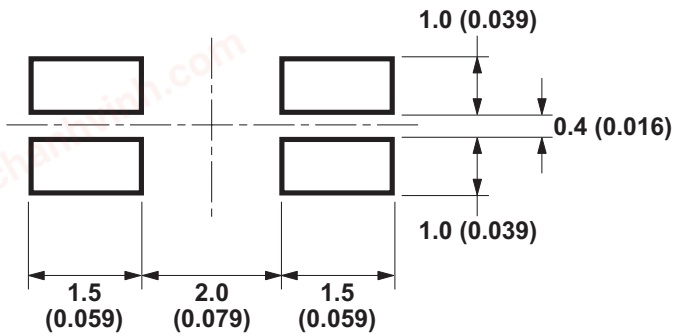


Figure 8: Recommended Solder Pad Pattern



NOTE: All dimensions are in millimeters (inches).

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Figure 9: Reeling Orientation

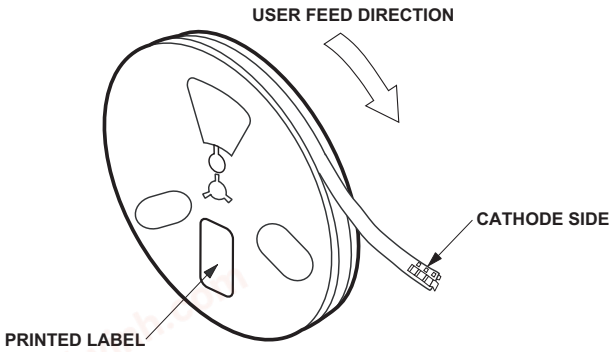
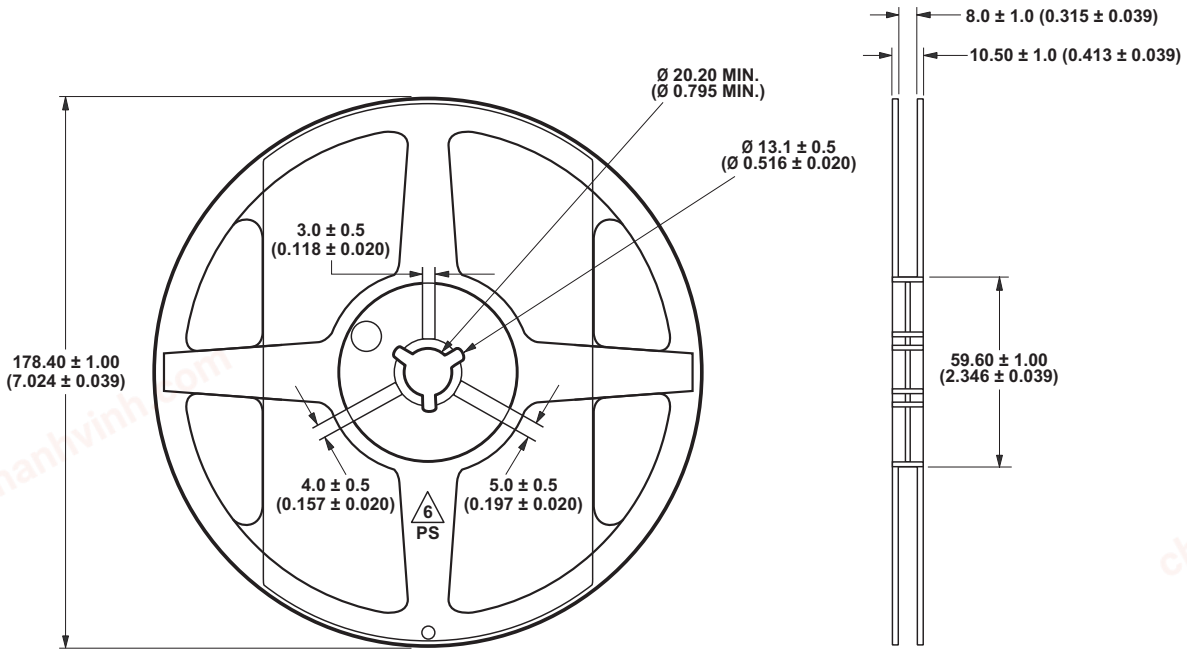


Figure 10: Reel Dimensions



NOTE: All dimensions are in millimeters (inches).

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Figure 11: Tape Dimensions

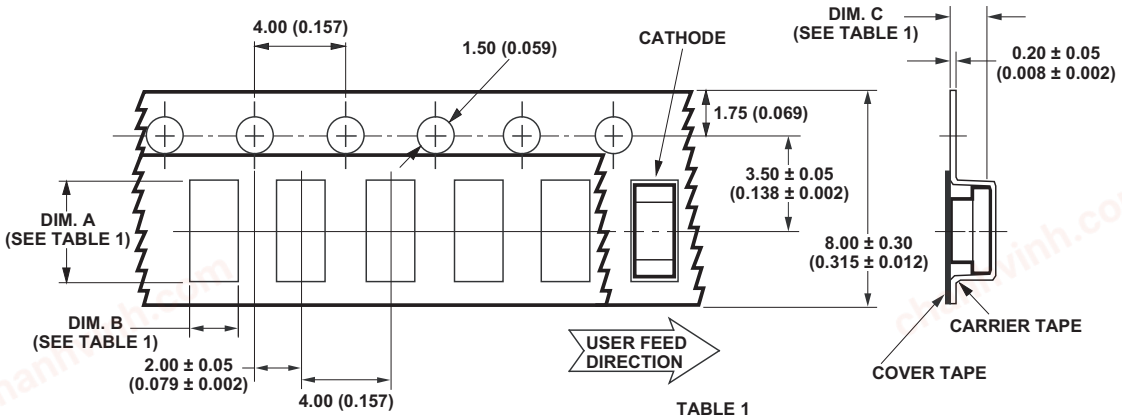
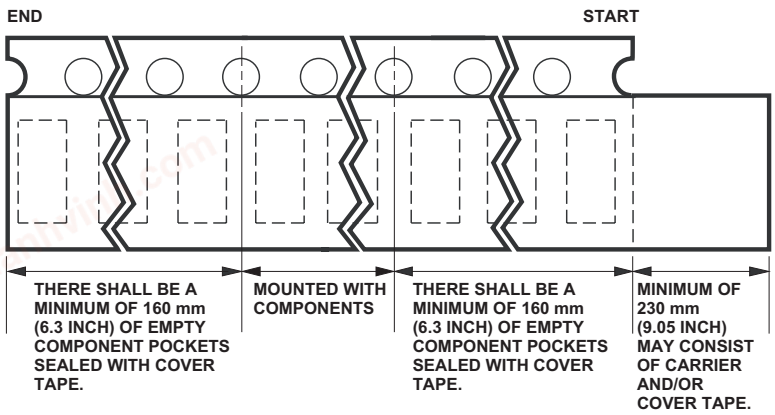


TABLE 1
DIMENSIONS IN MILLIMETERS (INCHES)

PART NUMBER	DIM. A ± 0.10 (0.004)	DIM. B ± 0.10 (0.004)	DIM. C ± 0.10 (0.004)
HSMF-C15x SERIES	3.52 (0.139)	3.02 (0.119)	1.40 (0.055)

Figure 12: Tape Leader and Trailer Dimensions



NOTE: All dimensions are in millimeters (inches).
Tolerance is ±0.1 mm (±0.004 in.) unless otherwise specified.

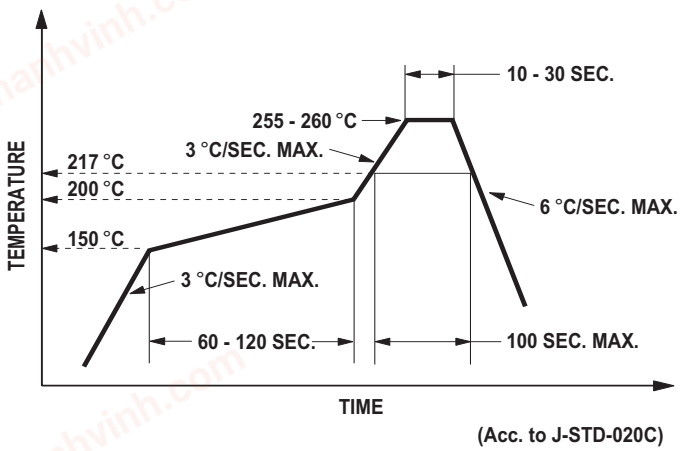
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Precautionary Notes

Soldering

- Do not perform reflow soldering more than twice. Observe necessary precautions of handling moisture-sensitive devices as stated in the following section.
- Do not apply any pressure or force on the LED during reflow and after reflow when the LED is still hot.
- Use reflow soldering to solder the LED. Use hand soldering only for rework if unavoidable, but it must be strictly controlled to following conditions:
  - Soldering iron tip temperature = 310°C maximum.
  - Soldering duration = 2 seconds maximum.
  - Number of cycles = 1 only.
  - Power of soldering iron = 50W maximum.
- 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.

Figure 13: Recommended Lead-Free Reflow Soldering Profile



Handling Precautions

This product has a Moisture Sensitive Level 2a rating per JEDEC J-STD-020. Refer to Broadcom Application Note AN5305, *Handling of Moisture Sensitive Surface Mount Devices*, for additional details and a review of proper handling procedures.

Before use:

- An unopened moisture barrier bag (MBB) can be stored at <40°C/90% RH for 12 months. If the actual shelf life has exceeded 12 months and the humidity indicator card (HIC) indicates that baking is not required, it is safe to reflow the LEDs per the original MSL rating.
- Do not open the MBB prior to assembly (for example, for IQC). If unavoidable, the MBB must be properly resealed with fresh desiccant and HIC. The exposed duration must be taken in as floor life.

Control after opening the MBB:

- Read the HIC immediately upon opening the MBB.
- Keep the LEDs at <30°/60% RH at all times, and complete all high temperature-related processes, including soldering, curing, or rework, within 672 hours.

Control for unfinished reel:

Store unused LEDs in a sealed MBB with desiccant or a desiccator at <5% RH.

Control of assembled boards:

If the PCB soldered with the LEDs is to be subjected to other high-temperature processes, store the PCB in a sealed MBB with desiccant or desiccator at <5% RH to ensure that all LEDs have not exceeded their floor life of 672 hours.

Baking is required if the following conditions exist:

- The HIC indicator indicates a change in color for 10% and 5%, as stated on the HIC.
- The LEDs are exposed to conditions of >30°C/60% RH at any time.
- The LEDs' floor life exceeded 672 hours.

The recommended baking condition is 60°C ± 5°C for 20 hours.

Baking can only be done once.

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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.
- 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 (such as intensity, wavelength, and forward voltage). Set the application current as close as possible to the test current to minimize these variations.
- Driving the LED at low current (<2 mA) does not cause functional failures to the LED (that is, open/short). However, the variation in intensity will be larger than existing intensity bin ratio of 1:1.6.
- If the LED is intended to be used along with LEDs of other colors to achieve color mixing, Broadcom does not guarantee the consistency of the resultant color. Contact your Broadcom sales representative for these applications.
- 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 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 an outdoor environment, protect the LED against damages caused by rain water, 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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