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BROADCOM®

Data Sheet

HLMP-S100, HLMP-S201, HLMP-S301, HLMP-S400, HLMP-S401, HLMP-S501

2 mm × 5 mm Rectangular LED Lamps



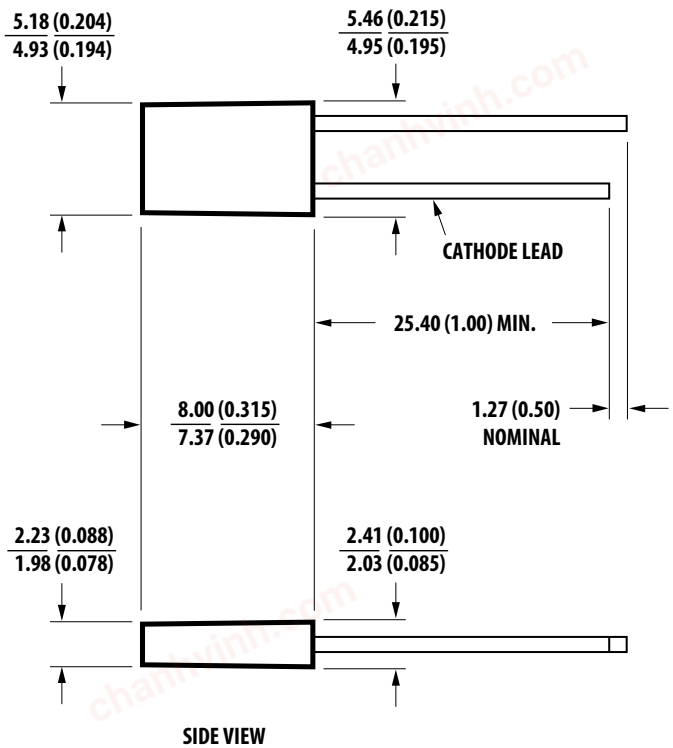
Description

The Broadcom® HLMP-S100, -S201, -S301, -S400, -S401, -S501, are epoxy encapsulated lamps in rectangular packages which are easily stacked in arrays or used for discrete front panel indicators. Contrast and light uniformity are enhanced by a special epoxy diffusion and tinting process.

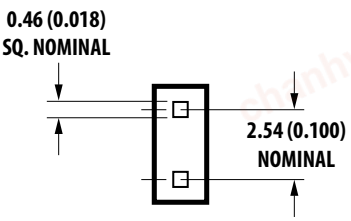
Features

- Rectangular light emitting surface
- Excellent for flush mounting on panels
- Choice of five bright colors
- Long life: solid state reliability
- AlInGaP LED technology
- Excellent uniformity of light output

Package Dimensions



SIDE VIEW



BOTTOM VIEW

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS (INCHES).
2. AN EPOXY MENISCUS MAY EXTEND ABOUT 1 mm (0.040") DOWN THE LEADS.
3. THERE IS A MXIMUM 1 TAPER FROM BASE TO THE TOP OF LAMP.

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Device Selection Guide

Color	Part Number	Luminous Intensity I_V (mcd) at 20 mA		
		Min.	Typ.	Max.
Deep Red	HLMP-S100	3.8	7.5	—
Red	HLMP-S201	3.8	7.5	—
	HLMP-S201-D00xx	2.4	3.5	—
Orange	HLMP-S400	2.4	3.5	—
	HLMP-S401	3.8	7.5	—
Yellow	HLMP-S301	2.5	4.0	—
	HLMP-S301-B00xx	1.6	2.1	—
	HLMP-S301-C00xx	2.5	4.0	—
Green	HLMP-S501	4.7	8.0	—
	HLMP-S501-C00xx	2.9	4.0	—
	HLMP-S501-D00xx	4.7	8.0	—

Absolute Maximum Ratings at T_A = 25°C

Parameter	Deep Red	Red/Orange	Green/Yellow	Unit
Peak Forward Current	300	90	60	mA
Average Forward Current[a]	20	25	20	mA
DC Current[b]	30	30	20	mA
LED Junction Temperature	110	110	110	°C
Operating Temperature Range	–20 to +100	–40 to +100	–40 to +100	°C
Storage Temperature Range	–40 to +100	–40 to +100	–40 to +100	°C

a. See Figure 5 to establish pulsed operating conditions.

b. For Deep Red, Red, Orange, and Green series, derate linearly from 50°C at 0.5 mA/°C. For Yellow series, derate linearly from 50°C at 0.34 mA/°C.

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Electrical/Optical Characteristics at T_A = 25°C

Description	Symbol	Device HLMP-	Min.	Typ.	Max.	Unit	Test Conditions
Included Angle Between Half Luminous Intensity Points	$2\theta^1/_2$	All	—	110	—	Deg.	I_F = 20 mA See Note [a]
Peak Wavelength	λ_p	Deep Red	—	660	—	nm	Measurement at Peak
		Red	—	632	—		
		Orange	—	610	—		
		Yellow	—	590	—		
		Green	—	570	—		
Dominant Wavelength	λ_d	Deep Red	—	640	—	nm	See Note [b]
		Red	—	626	—		
		Orange	—	605	—		
		Yellow	—	589	—		
		Green	—	569	—		
Speed of Response	τ_S	Deep Red	—	30	—	ns	Time const, $e^{-t/\tau s}$
		Red	—	90	—		
		Orange	—	280	—		
		Yellow	—	90	—		
		Green	—	500	—		
Capacitance	C	Deep Red	—	30	—	pF	V_F = 0; f = 1 MHz
		Red	—	11	—		
		Orange	—	4	—		
		Yellow	—	15	—		
		Green	—	18	—		
Thermal Resistance	$R\theta_{J\text{-}PIN}$	All	—	260	—	°C/W	Junction to Cathode Lead at Seating Plane
Forward Voltage	V_F	Deep Red	1.6	2.0	2.4	V	I_F = 20 mA
		Red/Orange	1.5	2.0	2.6		
		Yellow	1.5	2.0	2.6		
		Green	1.5	2.1	3.0		
Reverse Breakdown Voltage	V_R	All	5.0	—	—	V	I_R = 100 µA
Luminous Efficacy	η_V	Deep Red	—	65	—	lm/W	See Note [c]
		Red	—	180	—		
		Orange	—	350	—		
		Yellow	—	500	—		
		Green	—	640	—		

a. $\theta^1/_2$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.

b. The dominant wavelength, λ_d, is derived from the CIE chromaticity diagram and represents the single wavelength that defines the color of the device.

c. The radiant intensity, I_e, in watts per steradian, can be found from the equation $I_e = I_V/\eta_V$, where I_V is the luminous intensity in candelas and η_V is luminous efficacy in lumens/watt.

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Part Numbering System

H	L	M	P	-	X_1	X_2	X_3	X_4	-	X_5	X_6	X_7	X_8	X_9

Code	Description	Option	
X_1	Package Type	S	Rectangular 2 mm x 5 mm
X_2	Color	1	Deep Red
		2	Red
		3	Yellow
		4	Orange
		5	Green
X_3 X_4	Brightness Level	00	Less Brightness
		01	Higher Brightness
X_5	Minimum Intensity Bin	Refer to Intensity Bin Limits table.	
X_6	Maximum Intensity Bin	0	Open binning (No max IV bin limit)
X_7	Color Bin Selection	0	Full color bin range
X_8X_9	Packaging Option	00	Bulk
		02	Tape and Reel, Straight Leads

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Bin Information

Intensity Bin Limits

Color	Bin	Intensity Range (mcd)	
		Min.	Max.
Red/Orange	D	2.4	3.8
	E	3.8	6.1
	F	6.1	9.7
	G	9.7	15.5
	H	15.5	24.8
	I	24.8	39.6
	J	39.6	63.4
	K	63.4	101.5
	L	101.5	162.4
	M	162.4	234.6
	N	234.6	340.0
	O	340.0	540.0
	P	540.0	850.0
	Q	850.0	1200.0
	R	1200.0	1700.0
	S	1700.0	2400.0
	T	2400.0	3400.0
	U	3400.0	4900.0
	V	4900.0	7100.0
	W	7100.0	10200.0
	X	10200.0	14800.0
	Y	14800.0	21400.0
	Z	21400.0	30900.0

Color	Bin	Intensity Range (mcd)	
		Min.	Max.
Yellow	B	1.6	2.5
	C	2.5	4.0
	D	4.0	6.5
	E	6.5	10.3
	F	10.3	16.6
	G	16.6	26.5
	H	26.5	42.3
	I	42.3	67.7
	J	67.7	108.2
	K	108.2	173.2
	L	173.2	250.0
	M	250.0	360.0
	N	360.0	510.0
	O	510.0	800.0
	P	800.0	1250.0
	Q	1250.0	1800.0
	R	1800.0	2900.0
	S	2900.0	4700.0
	T	4700.0	7200.0
	U	7200.0	11700.0
	V	11700.0	18000.0
	W	18000.0	27000.0
Green	A	1.1	1.8
	B	1.8	2.9
	C	2.9	4.7
	D	4.7	7.6
	E	7.6	12.0
	F	12.0	19.1
	G	19.1	30.7
	H	30.7	49.1
	I	49.1	78.5
	J	78.5	125.7
	K	125.7	201.1
	L	201.1	289.0
	M	289.0	417.0
	N	417.0	680.0
	O	680.0	1100.0
	P	1100.0	1800.0
	Q	1800.0	2700.0
	R	2700.0	4300.0
	S	4300.0	6800.0
	T	6800.0	10800.0
	U	10800.0	16000.0
	V	16000.0	25000.0
	W	25000.0	40000.0

Maximum tolerance for each bin limit is ±18%.

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Color Categories

Color	Category #	Min.	Max.
Green	6	561.5	564.5
	5	564.5	567.5
	4	567.5	570.5
	3	570.5	573.5
	2	573.5	576.5
Yellow	1	582.0	584.5
	3	584.5	587.0
	2	587.0	589.5
	4	589.5	592.0
	5	592.0	593.0

Color	Category #	Min.	Max.
Orange	1	597.0	599.5
	2	599.5	602.0
	3	602.0	604.5
	4	604.5	607.5
	5	607.5	610.5
	6	610.5	613.5
	7	613.5	616.5
	8	616.5	619.5

Tolerance for each bin limit is ±0.5 nm.

Packaging Option Matrix

Packaging Option Code	Definition
00	Bulk Packaging, minimum increment 500 pieces/bag
02	Tape and Reel, straight leads, minimum increment 1300 pieces/reel

NOTE: All categories are established for classification of products. Products might not be available in all categories. Contact your local Broadcom representative for further clarification/information.

Figure 1: Relative Intensity vs. Wavelength

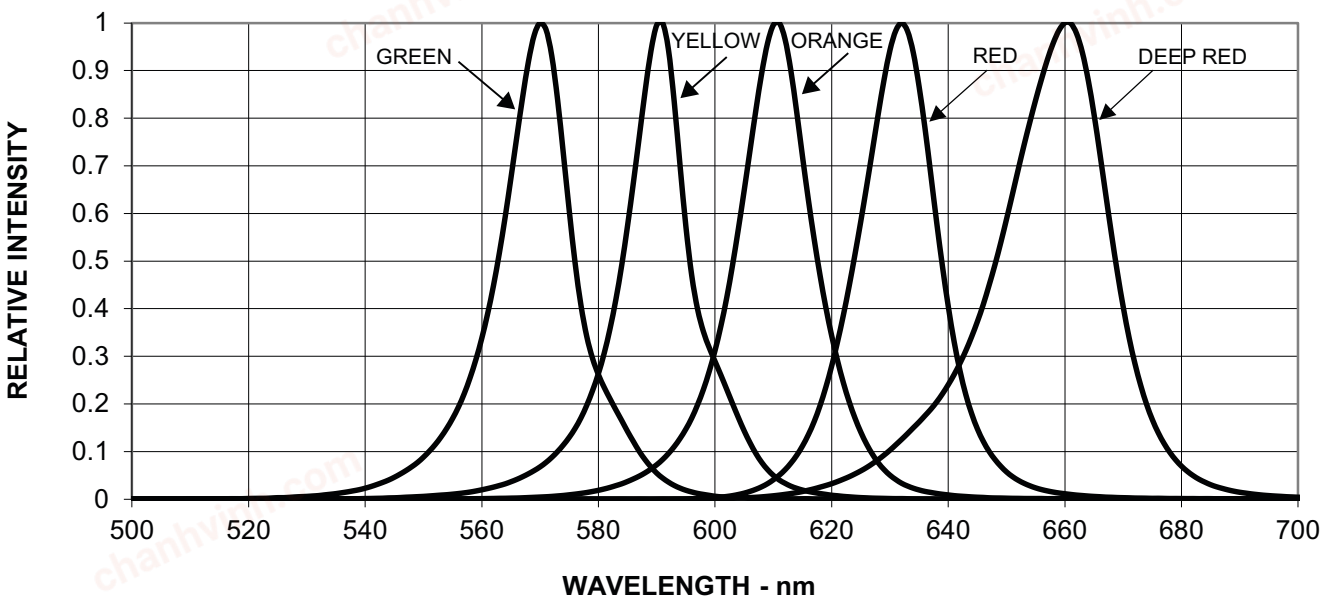

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Figure 2: Forward Current vs. Forward Voltage

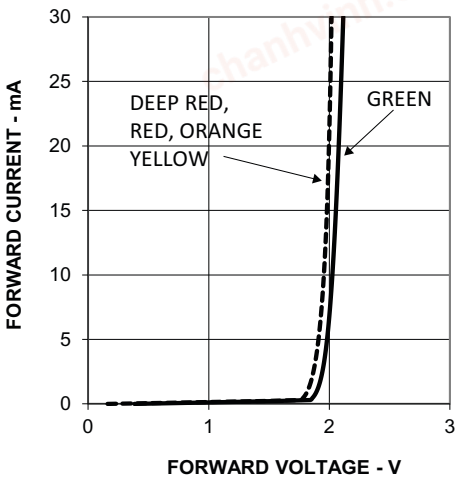


Figure 3: Relative Luminous Intensity vs. DC Forward Current

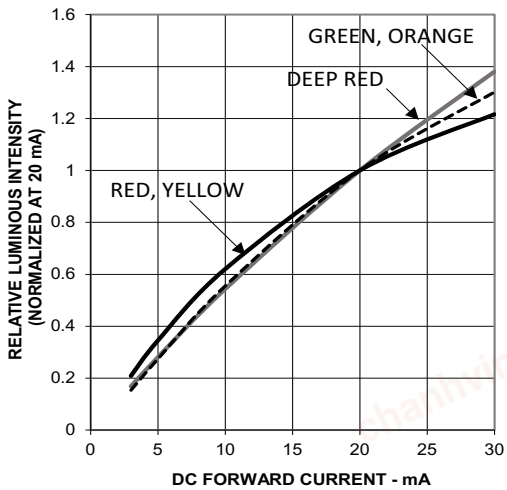


Figure 4: Maximum Tolerable Peak Current vs. Peak Duration (I_{PEAK} MAX determined from temperature derated I_{DC} MAX.)

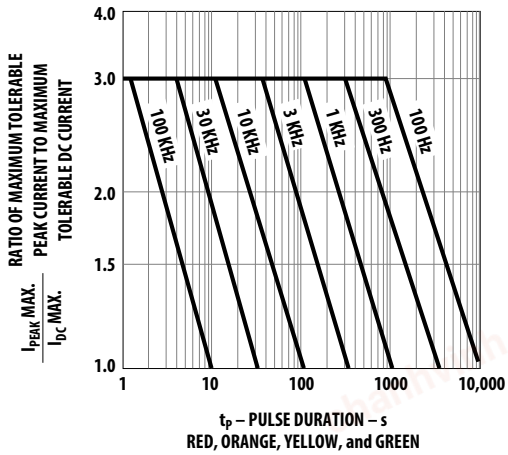


Figure 5: Maximum Tolerable Peak Current vs. Peak Duration (I_{PEAK} MAX determined from temperature derated I_{DC} MAX.)

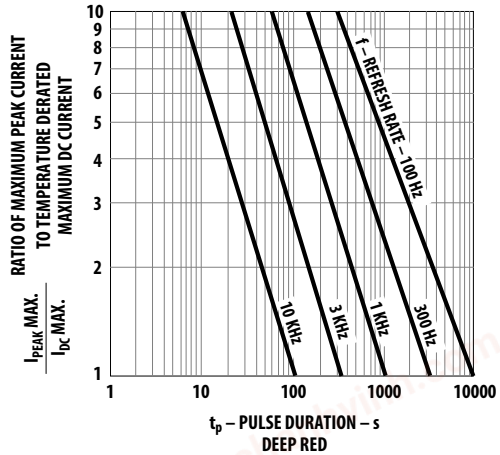
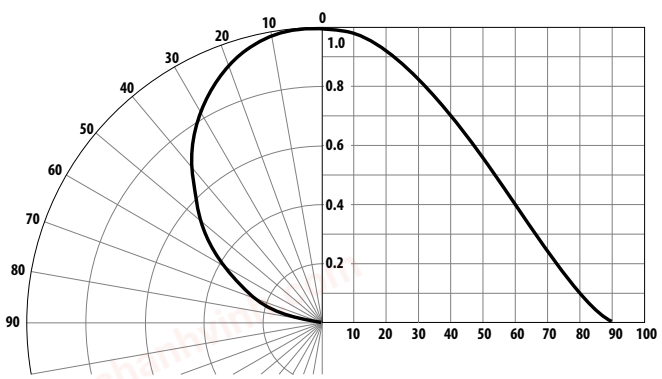


Figure 6: Relative Luminous Intensity vs. Angular Displacement



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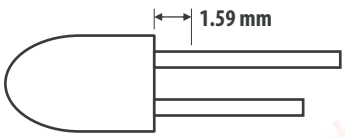
Precautions

Lead Forming

- The leads of an LED lamp may be preformed or cut to length prior to insertion and soldering on PC board.
- For better control, use the proper tool to precisely form and cut the leads to applicable length rather than doing it manually.
- If manual lead cutting is necessary, cut the leads after the soldering process. The solder connection forms a mechanical ground that prevents mechanical stress due to lead cutting from traveling into the LED package. Use this method for the hand soldering operation, because the excess lead length also acts as small heat sink.

Soldering and Handling

- Take care during the PCB assembly and soldering process to prevent damage to the LED component.
- The LED component may be effectively hand soldered to the PCB. However, do this under unavoidable circumstances, such as rework. The closest manual soldering distance of the soldering heat source (soldering iron's tip) to the body is 1.59 mm. Soldering the LED using soldering iron tip closer than 1.59 mm might damage the LED.



- Apply ESD precautions on the soldering station and personnel to prevent ESD damage to the LED component that is ESD sensitive. Refer to Broadcom application note AN 1142 for details. The soldering iron used must have a grounded tip to ensure electrostatic charge is properly grounded.
- Recommended soldering condition.

	Wave Soldering[a, b]	Manual Solder Dipping
Pre-heat Temperature	105°C max.	—
Pre-heat Time	60s max.	—
Peak Temperature	250°C max.	260°C max.
Dwell Time	3s max.	5s max.

a. The preceding conditions refer to measurement with a thermocouple mounted at the bottom of the PCB.

b. Use only bottom pre-heaters to reduce thermal stress experienced by LED.

- Set and maintain wave soldering parameters according to the recommended temperature and dwell time. Perform daily checks on the soldering profile to ensure that it always conforms to the recommended soldering conditions.

NOTE:

1. PCBs with different size and design (component density) will have a different heat mass (heat capacity). This might cause a change in temperature experienced by the board if the same wave soldering setting is used. Therefore, recalibrate the soldering profile again before loading a new type of PCB.
2. Take extra precautions during wave soldering to ensure that the maximum wave temperature does not exceed 250°C and the solder contact time does not exceed 3s. Overstressing the LED during the soldering process might cause premature failure to the LED due to delamination.

- Loosely fit any alignment fixture that is being applied during wave soldering and do not apply weight or force on the LED. Use non-metal material because it will absorb less heat during the wave soldering process.
- At elevated temperature, the LED is more susceptible to mechanical stress. Therefore, allow the PCB to cool down to room temperature prior to handling, which includes removal of alignment fixture or pallet.
- If the PCB board contains both through-hole (TH) LED and other surface-mount components, solder surface-mount components on the top side of the PCB. If the surface mount must be on the bottom side, solder these components using reflow soldering prior to the insertion of the TH LED.
- The recommended PC board plated through holes (PTH) size for LED component leads follows.

LED Component Lead Size	Diagonal	Plated Through-Hole Diameter
0.457 × 0.457 mm (0.018 × 0.018 in.)	0.646 mm (0.025 in.)	0.976 to 1.078 mm (0.038 to 0.042 inch)
0.508 x 0.508 mm (0.020 x 0.020 inch)	0.718 mm (0.028 in.)	1.049 to 1.150 mm (0.041 to 0.045 inch)

- Oversizing the PTH can lead to a twisted LED after clinching. On the other hand, undersizing the PTH can cause difficulty inserting the TH LED.

Refer to application note AN1027 for more information about soldering and handling of TH LED lamps.

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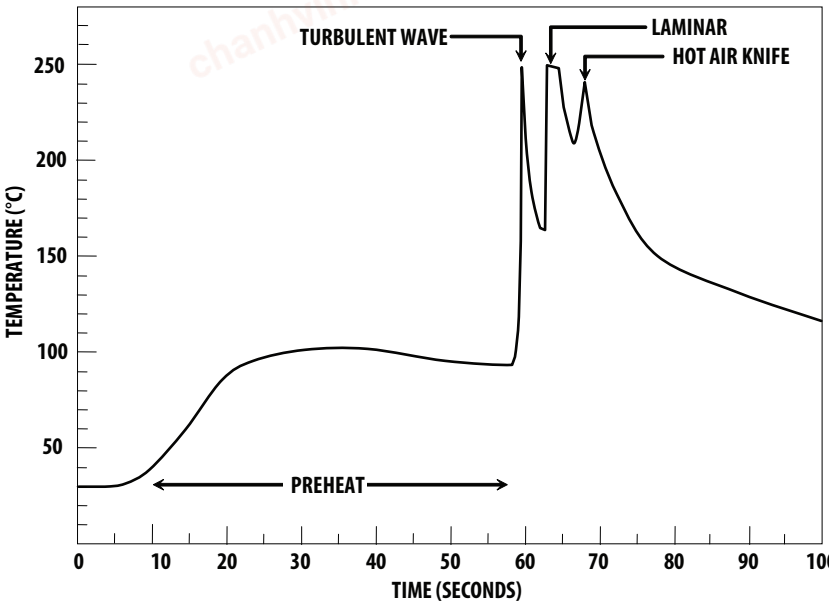
Figure 7: Example of Wave Soldering Temperature Profile for TH LED



Recommended solder:
Sn63 (Leaded solder alloy)
SAC305 (Lead free solder alloy)

Flux: Rosin flux

Solder bath temperature:
245°C± 5°C (maximum peak temperature = 250°C)

Dwell time: 1.5 sec – 3.0 sec (maximum = 3sec)

Note: Allow for board to be sufficiently cooled to room temperature before exerting mechanical force.

Recommended solder:
Sn63 (Leaded solder alloy)
SAC305 (Lead free solder alloy)

Flux: Rosin flux

Solder bath temperature:
245°C± 5°C (maximum peak temperature = 250°C)

Dwell time: 1.5 sec – 3.0 sec (maximum = 3sec)

Note: Allow for board to be sufficiently cooled to room temperature before exerting mechanical force.

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