

# HLMP-LG75/LM75/LB75

Red, Green, Blue

4mm Standard Oval LEDs



## Reliability Data Sheet

### Description

The following cumulative test results have been obtained from testing performed at Avago Technologies in accordance with JEDEC standard.

Avago tests parts at the absolute maximum rated conditions recommended for the device. The actual performance you obtain from Avago parts depends on the electrical and environmental characteristics of your application but will probably be better than the performance outlined in Table 1.

### Failure Rate Prediction

The junction temperature of the device determines the failure rate of semiconductor devices. The relationship between ambient temperature and actual junction temperature is given by the following:

$$T_J (\text{°C}) = T_A (\text{°C}) + \theta_{JA} P_{AVG}$$

where

$T_A$  = ambient temperature in °C

$\theta_{JA}$  = thermal resistance of junction-to-ambient in °C/Watt

$P_{AVG}$  = average power dissipated in Watt

The estimated MTTF and failure rate at temperatures lower than the actual stress temperature can be determined by using an Arrhenius model for temperature acceleration. Results of such calculations are shown in the table below using activation energy of 0.43eV (reference MIL-HDBK-217).

**Table 1. Life Tests**

### Demonstrated Performance

Colors	Stress Test Conditions	Total Device Hours	Units Tested	Total Failed	Point Typical Performance	
					MTTF (60% Confidence)	Failure Rate (% /1K Hours)
AllnGaP (Red)	$T_A = 70^{\circ}\text{C}$ $I_F = 37 \text{ mA}$	224,000	224	0	251,100	0.40
InGaN (Green, Blue)	$T_A = 55^{\circ}\text{C}$ $I_F = 23 \text{ mA}$	224,000	224	0	249,100	0.40

**Table 2. Reliability Prediction : Red**

Ambient Temperature (°C)	Junction Temperature (°C)	I <sub>F</sub>	Point Typical Performance <sup>[1]</sup> in Time (60% Confidence)		Point Typical Performance <sup>[2]</sup> in Time (90% Confidence)	
			MTTF	Failure Rate (%/1K Hours)	MTTF	Failure Rate (%/1K Hours)
100	129	18	252,100	0.40	100,300	1.00
95	129	21	251,900	0.40	100,300	1.00
90	129	24	251,800	0.40	100,200	1.00
85	129	27	251,600	0.40	100,100	1.00
80	129	30	251,400	0.40	100,100	1.00
75	129	33	251,300	0.40	100,000	1.00
70	130	36	251,100	0.40	99,900	1.00
65	130	40	250,900	0.40	99,900	1.00
60	130	43	250,800	0.40	99,800	1.00
55	130	46	250,600	0.40	99,800	1.00
50	130	49	250,400	0.40	99,700	1.00
45	127	50	274,800	0.36	109,400	0.91
40	122	50	321,900	0.31	128,100	0.78
35	117	50	378,600	0.26	150,700	0.66
30	112	50	447,200	0.22	178,000	0.56
25	107	50	530,600	0.19	211,200	0.47

**Table 3. Reliability Prediction : Green/Blue**

Ambient Temperature (°C)	Junction Temperature (°C)	I <sub>F</sub>	Point Typical Performance <sup>[1]</sup> in Time (60% Confidence)		Point Typical Performance <sup>[2]</sup> in Time (90% Confidence)	
			MTTF	Failure Rate (%/1K Hours)	MTTF	Failure Rate (%/1K Hours)
85	109	10	253,900	0.39	101,100	0.99
80	109	12	253,100	0.40	100,800	0.99
75	109	14	252,300	0.40	100,400	1.00
70	109	16	251,500	0.40	100,100	1.00
65	109	19	250,700	0.40	99,800	1.00
60	109	21	249,900	0.40	99,500	1.01
55	110	23	249,100	0.40	99,200	1.01
50	110	25	248,300	0.40	98,800	1.01
45	110	27	247,500	0.40	98,500	1.02
40	110	29	246,700	0.41	98,200	1.02
35	107	30	273,200	0.37	108,700	0.92
30	102	30	325,500	0.31	129,600	0.77
25	97	30	389,700	0.26	155,100	0.64
20	92	30	468,800	0.21	186,600	0.54
15	87	30	567,000	0.18	225,700	0.44
10	82	30	689,300	0.15	274,400	0.36

Notes:

1. The 60% or 90% confidence MTTF represents the minimum level of reliability performance which is expected from 60% or 90% of all samples. The confidence level is established based on the chi-square distribution.
2. Failure rate (FIT) is  $1/MTTF \times 10^5$ , assuming the failures are exponentially distributed
3. A failure is any LED that is open, shorted or fails to emit light.
4. Calculated from data generated at 70°C biased at 37mA(Red) and 55°C biased at 23mA( Green/Blue)
5. Junction temperature is calculated based on  $\theta_{JA} = 680^\circ\text{C/W}$ ( Red) and  $\theta_{JA} = 630^\circ\text{C/W}$ ( Green/Blue)

### Example of Failure Rate Calculation

Assume a device operating 8 hours/day, 5 days/week. The utilization factor, given 168 hours/week is:

$$(8 \text{ hours/day}) \times (5 \text{ days/week}) / (168 \text{ hours/week}) = 0.24$$

The point failure rate per year (8760 hours) at 25°C ambient temperature is (60% confidence level) :

$$(0.26\% / 1\text{K hours}) \times 0.24 \times (8760 \text{ hours/year}) = 0.55\% \text{ per year}$$

Similarly, 90% confidence level failure rate per year at 25°C:

$$(0.64\% / 1\text{K hours}) \times 0.24 \times (8760 \text{ hours/year}) = 1.34\% \text{ per year}$$

**Table 4. Environmental/Mechanical Tests**

Test Name	Reference	Test Conditions	Units Tested	Units Failed
Temperature Cycle	Avago Req.	-40/100°C 30 min dwell, 5 min transfer, 100 cycles	2686	0
High Temperature Operating Life	JESD22-A108	Red : $T_A = 70^\circ\text{C}$ , $I_F = 37 \text{ mA}$ , for 1000hrs Green/Blue: $T_A = 55^\circ\text{C}$ , $I_F = 23 \text{ mA}$ for 1000hrs	448	0
Low Temperature Operating Life	JESD22-A108	Red: $T_A = -40^\circ\text{C}$ , $I_F = 50 \text{ mA}$ for 1000 hours Green/Blue: $T_A = -40^\circ\text{C}$ , $I_F = 30 \text{ mA}$ for 1000hrs	336	0
Temperature Humidity Operating Life	JESD22-A101	$T_A = 85^\circ\text{C}$ , 85%RH, for 500 hours Red : $I_F = 27 \text{ mA}$ Green/Blue: $I_F = 10 \text{ mA}$	616	0
Room Temperature Operating Life	Avago Req	$T_a = 25^\circ\text{C}$ for 1000hrs Red : $I_F = 50 \text{ mA}$ Green/Blue: $I_F = 30 \text{ mA}$	168	0
Temperature Humidity Storage Life	Avago Req.	$T_A = 85^\circ\text{C}$ , 85%RH, for 1000 hours	952	0
Pulse Test	Avago Req.	$T_A = 55^\circ\text{C}$ , Frequency = 1kHz, 1000 hours Peak Current = 100 mA, Red: Duty factor = 30%, Green/Blue: Duty factor = 10%,	336	0
Resistance To Solder Heat	JESDB106	260+/-5°C, 10+/-5 second	180	0

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