

**HLMP-EG1A/1B,HLMP-EL1A/1B,
HLMP-EG2A/2B,HLMP-EL2A/2B,
HLMP-EG3A/3B,HLMP-EL3A/3B**



New T-1¾ (5mm) Extra High Brightness AlInGaP LED Lamps

Reliability Data Sheet

Description

The following cumulative test results have been obtained from testing performed at Avago Technologies in accordance with the latest revision of MIL-STD-883 and JEDEC.

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

θ_{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	$T_A = 100\text{°C}$ $I_F = 20\text{ mA}$	56,000	56	0	57,700	1.73

Table 2. Reliability Prediction
AllnGaP (I_F = 30mA)

Ambient Temperature (°C)	Junction Temperature (°C)	Point Typical Performance in Time ^[1-5] (60% Confidence)		Performance in Time ^[1-5] (90% Confidence)	
		MTTF	Failure Rate (%/1K Hours)	MTTF	Failure Rate (%/1K Hours)
100	130	57700	1.73	23000	4.35
95	130	57700	1.73	23000	4.35
90	130	57600	1.74	22900	4.37
85	130	57500	1.74	22900	4.37
80	130	57400	1.74	22900	4.37
75	130	57300	1.75	22800	4.39
70	130	57200	1.75	22800	4.39
65	130	57200	1.75	22800	4.39
60	130	57100	1.75	22700	4.41
55	125	66700	1.50	26500	3.77
50	120	78200	1.28	31100	3.22
45	115	92000	1.09	36600	2.73
40	110	108800	0.92	43300	2.31
35	105	129300	0.77	51500	1.94
30	100	154200	0.65	61400	1.63
25	95	184900	0.54	73600	1.36

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 $1/\text{MTTF} \times 10^5$, 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 100°C biased at 20mA.
5. Junction temperature is calculated based on $\theta_{JA} = 670^\circ\text{C/W}$

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) :

$$(0.54\% / 1\text{K hours}) \times 0.24 \times (8760 \text{ hours/year}) = 1.13\% \text{ per year}$$

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

$$(1.36\% / 1\text{K hours}) \times 0.24 \times (8760 \text{ hours/year}) = 2.86\% \text{ per year}$$

Table 3. Environmental Tests

Test Name	Reference	Test Conditions	Units Tested	Units Failed
Temperature Cycle	Avago Req.	-40/100°C 15 min dwell, 5 min transfer, 100 cycles	2224	0
Resistance to Soldering Heat	JESD 22-B106	260°C for 10 seconds, 2x	30	0
Low Temperature Operating Life	JESD 22-A108	T _A = -40°C, I _F = 50 mA for 1000 hours	28	0
Temperature Humidity Operating Life	JESD 22-A101	T _A = 85°C, 85%RH, I _F = 30 mA for 1000 hours	28	0
Temperature Humidity Storage Life	Avago Req.	T _A = 85°C, 85%RH for 1000 hours	28	0

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