HLMP-LG70/71,HLMP-LB71
HLMP-LM71

4 mm Oval Precision Optical Performance LED

Reliability Datasheet

Description

The following cumulative test results have been obtained from testing performed at Avago Technologies in accordance with the latest revisions of MIL-STD-883 and JIS C 7021.

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

Failure Rate Prediction

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

T_J (°C) = T_A (°C) + θ_{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 watts

The estimated MTBF 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 on the following page using activation energy of 0.43 eV (reference MIL-HDBK-217).

Table 1. Life Tests
Demonstrated Performance

					Point Typical Performance	
					Failure Rate	
Die Type	Stress Test Conditions	Total Device Hrs.	Units Tested	Units Failed	MTBF	(% /1 K Hours)
AlInGap	T_A = 55° C I_F = 47 mA	168,000	168	0	189200	0.53
InGaN	T_A = 55° C I_F = 23 mA	672,000	672	0	747,100	0.13

Table 2. Reliability Predictions ($I_F = 20$ mA)
Die Type: AlInGaP

		Point Typical Performance in Time [1] (60% Confidence)		Performance in Time [2] (90% Confidence) Failure Rate	
Ambient Temperature (°C)	Junction Temperature (°C)	MTTF [1]	Failure Rate (%/1 K Hours)	MTTF [2]	(%/1 K Hours)
100	130	178300	0.56	71000	1.41
95	130	179500	0.56	71400	1.40
90	129	180600	0.55	71900	1.39
85	129	181800	0.55	72400	1.38
80	129	183000	0.55	72900	1.37
75	129	184200	0.54	73300	1.36
70	129	185500	0.54	73800	1.36
65	128	186700	0.54	74300	1.35
60	128	187900	0.53	74800	1.34
55	128	189200	0.53	75300	1.33
50	128	190400	0.53	75800	1.32
45	124	216200	0.46	86100	1.16
40	119	253800	0.39	101000	0.99
35	114	299300	0.33	119100	0.84
30	109	354400	0.28	141100	0.71
25	104	421500	0.24	167800	0.60
20	99	503700	0.20	200500	0.50

Table 3. Reliability Predictions ($I_F = 20$ mA)
Die Type: InGaN

		Point Typical Performance in Time [1] (60% Confidence)		Performance in Time [2] (90% Confidence) Failure Rate	
Ambient Temperature (°C)	Junction Temperature (°C)	MTTF [1]	Failure Rate (%/1 K Hours)	MTTF [2]	(%/1 K Hours)
85	108	742500	0.13	295600	0.34
80	108	743300	0.13	295900	0.34
75	108	744100	0.13	296200	0.34
70	108	744800	0.13	296500	0.34
65	108	745600	0.13	296800	0.34
60	108	746300	0.13	297100	0.34
55	108	747100	0.13	297400	0.34
50	108	747900	0.13	297700	0.34
45	108	748600	0.13	298000	0.34
40	108	749400	0.13	298300	0.34
35	105	831800	0.12	331100	0.30
30	100	992700	0.10	395200	0.25
25	95	1190500	0.08	473900	0.21
20	90	1434900	0.07	571200	0.18
15	85	1738500	0.06	692000	0.14
10	80	2117700	0.05	843000	0.12
5	75	2594400	0.04	1032700	0.10

Notes:
1. The point typical MTBF (which represents 60% confidence level) is the total device hours divided by the number of failures. In the case of zero failures, one failure is assumed for this calculation.
2. The 90% Confidence MTBF represents the minimum level of reliability performance which is expected from 90% of all samples. This confidence interval is based on the statistics of the distribution of failures. The assumed distribution of failures is exponential. This particular distribution is commonly used in describing useful life failures. Refer to MIL-STD-690B for details on this methodology.
3. A failure is any LED which is open, shorted, or fails to emit light
4. Calculated from data generated at 55° C biased at 50 mA.

Failure Rate Calculation (Example AlInGaP Die Type Package):

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

(8 hours/day) x (5 days/week) / (168 hours/week) = 0.24

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

(0.24%/1 K hours) x (0.24) x (8760 hours/year) = 0.5% per year

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

(0.6%/1 K hours) x (0.24) x (8760 hours/year) = 1.26% per year

Table 4. Environmental/ Operating Tests

Test Name	MIL-STD/JEDEC Reference	Test Conditions	Units Tested	Units Failed
Temperature Cycle	JESDA104	-40°C/100°C, 30 min dwell, 5 min transfer, 100 cycles	3744	0
Temperature Humidity Operating Life	JESD 22-A101	T_A = 85° C, RH = 85%RH, 1000 hrs AlInGaP 28 mA, InGaN 10 mA	84	0
High Temperature Operating Life	JESDA103	T_A = 55° C, 1000 hrs AlInGaP 47 mA, InGaN 23 mA	168	0
Low Temperature Operating Life	JESD 22-A108	T_A = -40° C, 1000 hrs AlInGaP 50 mA, InGaN 30 mA	84	0
Temperature Humidity Storage Life	Avago Requirement	T_A = 85° C, RH = 85%RH, 1000 hrs	672	0
Pulse Test	Avago Requirement	T_A = 85° C, If = 100 mA, Peak, Freq: 1 Khz, AlInGaP DF: 30%; InGaN DF: 10%	84	0
Resistance to Solder heat	JESDB106	260+/-5° C, 10+/-2 second, 2x	30	0

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AV02-3406EN - March 30, 2012

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