

T-1 ³/₄ (5 mm) Base Lamp (AlInGaP)

Reliability Data

HLMP-C008/C208/C608/ C025/C225/C325/C625

Description

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

Table 1. Life Tests

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

Demonstrated Performance							
					Point Typical Performance		
Colors	Stress Test Conditions	Total Device Hrs.	Units Tested	Units Failed	MTBF	Failure Rate (% /1K Hours)	
Red (626 nm dominant)	$\begin{array}{l} T_A=55^\circ C,\\ I_F=50\ mA \end{array}$	112,000	112	0	112,000	0.893	
Red (626 nm dominant)	$T_A = -40^{\circ}C,$ $I_F = 50 \text{ mA}$	112,000	112	0	112,000	0.893	

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:

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 an activation energy of 0.43 eV (reference MIL-HDBK-217).

 $T_J (^{\circ}C) = T_A (^{\circ}C) + \theta_{JA} P_{AVG}$

		Point Performar (60% C	t Typical nce in Time [1] onfidence)	Performance in Time [2] (90% Confidence)	
Ambient Temperature (°C)	Junction Temperature (°C)	MTBF [1]	Failure Rate (%/1K Hours)	MTBF [2]	Failure Rate (%/1K Hours)
55	88	112,000	0.893	49,000	2.056
45	78	166,000	0.602	72,000	1.692
35	68	252,000	0.396	110,000	0.912
25	58	393,000	0.254	171,000	0.585

Table 2. Reliability Predictions ($I_F = 50 \text{ mA}$) [4]

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.

Example of Failure Rate Calculation

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) = 0.25

The point failure rate per year (8760 hours) at 55°C ambient temperature is: (0.893% / 1K hours) x (0.25) x (8760 hours/year) = 1.96% per year

Similarly, 90% confidence level failure rate per year at 55°C: (2.056% / 1K hours) x (0.25) x (8760 hours/year) = 4.50% per year

 Table 3. Environmental Tests

Test Name	MIL-STD-883 Reference	JIS C 7021 Reference	Test Conditions	Units Tested	Units Failed
Temperature Cycle	1010	Method A-4	-40°C to 120°C; 30 min. dwell, 5 min. transfer, 500 cycles	2,300	0
Resistance to Soldering Heat	2003	Method A-1 Cond. A	260°C for 10 sec.	264	0
Resistance to Soldering Heat	2003	Method A-1 Cond. A	260°C for 5 sec. / 2x dip.	264	0
Solderabilty	2003	Method A-2	230°C for 5 sec. 1 to 1.5 mm from body, 95% solder coverage of immersed area	80	0
High Temp. Storage	1005	Method B-10	120°C for 1,000 hours	28	0
Low Temp. Storage	1005		-40°C for 1,000 hours	28	0
Temperature Shock	Agilent Req.	Agilent Req.	-30°C to 100°C, 30 min. dwell and <20 second transfer. 200 cycles	500	0
Power Temp. Cycle	Agilent Req.	Agilent Req.	-40°C to 85°C; 18 min. dwell, 42 min. transfer and 5 min. on/off @ 20 mA. 1000 cycles	168	0
Humidity Life	Agilent Req.	Agilent Req.	85°C, 85%RH, 10 mA, 1000 hours	28	0
Resistance to Solvents	2015	N/A	 Z Propanol/mineral spirit solution Z Propylene glycol monomethylether/monoethanolamine/ DI water solution(1:1:42 by volume). Semiaquous solvent with a minimum of 60% limonene and Skysol 600. 	22	0
Moisture Resistance	N/A	Method B-11 Cond.B	60°C, 90-95% R/H. 1,000 hours. Performed 1,000 hours	28	0

Table 4. Mechanical Tests

Test Name	MIL-STD-883 Reference	Test Conditions	Units Tested	Units Failed
Mechanical Shock	2002	1,500 G's applied by 5 shocks in each axis X1, Y1 and Z1.	22	0
Terminal Strength	2004 Cond. A	1/2 pound for 30 seconds, 15 degree bend, 1X.	22	0



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