HEWLETT PACKARD

T-1 (3 mm) High Performance AlInGaP Plastic Lamps

Reliability Data

QLMP-N4XX QLMP-J2XX
QLMP-J3XX QLMP-NLXX
QLMP-K4XX QLMP-J5XX
QLMP-KHXX QLMP-KLXX

Description

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

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

Table 1. Life Tests

Demonstrated Performance

					Point Typical Performance	
Colors	**Stress Test Conditions**	**Total Device Hrs.**	**Units Tested**	**Total Failed[3]**	**MTBF**	**Failure Rate (% /1K Hours)**
AS AlInGaP	T_A = 25°C, I_F = 50 mA	1,288,000	756	0	1,288,000	0.078
AS AlInGaP	T_A = 100°C, I_F = 30 mA	896,000	448	0	896,000	0.112
AS AlInGaP	T_A = 85°C/85%RH, I_F = 20 mA	336,000	224	0	336,000	0.29
AS AlInGaP	T_A = 55°C, I_F = 50 mA	448,000	112	0	448,000	0.128
AS AlInGaP	T_A = -40°C, I_F = 30 mA	896,000	280	0	896,000	0.112

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:

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

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

Table 2. (I_F = 50 mA [4])

		Point Typical Performance [1] in Time		Performance in Time [2] (90% Confidence)	
Ambient Temperature (°C)	**Junction Temperature (°C)**	**MTBF [1]**	**Failure Rate (%/1K Hours)**	**MTBF [2]**	**Failure Rate (%/1K Hours)**
+75	+108	217,000	0.461	94,000	1.062
+65	+98	309,000	0.324	134,000	0.746
+55	+88	448,000	0.223	195,000	0.514
+45	+78	664,000	0.151	288,000	0.347
+35	+68	1,008,000	0.099	438,000	0.228
+25	+58	1,568,000	0.064	681,000	0.147

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 25°C ambient temperature is:

(0.064%/ 1K hours) x 0.25 x (8760 hours/year) = 0.14% per year

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

(0.147%/ 1K hours) x 0.25 x (8760 hours/year) = 0.32% per year

Table 3. Environmental Tests

Test Name	MIL-STD-883 Ref.	JIS C 7021 Ref.	Test Conditions	Units Tested	Units Failed
Temperature Cycle	1010	Method A-4	-55°C to +100°C, 15 min. dwell, 5 minute transfer, 500 cycles	1,300	0
Resistance to Soldering Heat	2003	Method A-1 Condition A	260°C for 10 sec.	500	0
Resistance to Soldering Heat	2003	Method A-1 Condition A	260°C for 5 sec./2x dip.	17,347	0
Solderability	2003	Method A-2	230°C for 5 sec. 1 to 1.5 mm from body, 95% solder coverage of immersed area	40	0
High Temp. Storage	1005	Method B-10	100°C for 3,000 hours	420	0
Low Temp. Storage	1005	Method B-12	-40°C for 3,000 hours	168	0
Power Temp. Cycle	H-P Req.	H-P Req.	-40°C to 85°C; 18 min. dwell, 42 min. transfer @ 30 mA, 100 cycles	1,396	2
Power Temp. Cycle	H-P Req.	H-P Req.	-40°C to 85°C; 15 min. dwell, 15 min. transfer @ 20 mA, 1000 cycles	373	0
Humidity Life	H-P Req.	H-P Req.	85°C, 85% RH, 20 mA, 1000 hours	448	0
Temp. Humidity Cycle Life	H-P Req.	H-P Req.	+25°C to 65°C; 80-90% RH, 5 min. on/off@ 20 mA	154	0
Temperature Humidity Cycle	1004	Method A-5 Method II	-10°C to 65°C, 90-98% RH, Performed 50 cycles	448	0
Resistance to Solvents	2015	N/A	1. Z Propanol/mineral spirit solution (1:3 by volume). 2. Propylene glycol monomethylether/monoehanolamine/ DI water solution (1:1:42 by volume). 3. Semiaquous solvent with a min. of 60% limonene and Skysol 600.	40	0
ESD		EIAJ ED-4701	Method C-111, Condition A	31	0
Moisture Resistance	N/A	Method B-11 Cond. B	60°C, 90-95% RH, 2000 hours. Performed 3,000 hours	224	0

Table 4. Mechanical Tests

Test Name	MIL-STD-883 Ref.	JIS C 7021 Ref.	Test Conditions	Units Tested	Units Failed
Mechanical Shock Test	2002	Method A-7 Condition F	Max. acceleration: 14700 m/s^2 with 0.5 m/s pulse width, 3x each direction	40	0
Vibration Variable Frequency	2007	Method A-10 Condition D	100-2000-100 Hz frequency range in 4 min., 196 m/s^2 peak to peak acceleration, 48 min. total	40	0
Free Drop Test	N/A	Method A-8	Drop from 75 cm 3x	40	0
Termination Strength	2004	Method A-11 Tests I and III	1 kg. load for 30 sec., 5N. load on lead with ±90° bend	40	0
Constant Acceleration	2001	Method A-9 Condition D	1 min. each 6 directions, 196,000 m/s^2	40	0

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Data Subject to Change

Obsoletes 5965-7847E

5968-4125E (2/99)