HEWLETT® PACKARD

Subminiature Lamps

Reliability Data

HLMP-Pxxx, Qxxx, 6xxx, 70xx

Description

The following cumulative test results have been obtained from testing performed at HP Optoelectronics Division in accordance with the latest revision of MIL- STD-883.

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

Colors	Stress Test Conditions	Total Device Hours	Units Tested	Total Failed	Point Typical Performance	
					MTBF	Failure Rate (% /1 K Hours)
Standard Red	T_A = 55°C, I_F = 50 mA	2,658,000	2,210	0	2,658,000	≤ 0.038%
HER, Green,	T_A = 55°C, I_F = 30 mA	10,423,000	7,063	0	10,423,000	≤ 0.010 %
Emerald Green, Orange, Yellow, AS and TS AlGaAs						
Yellow	T_A = 55°C, I_F = 20 mA	3,218,000	2,098	0	3,218,000	≤ 0.031 %

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:

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

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

Table 2.

I_F	Ambient Temp. (°C)	Junction Temp. (°C)	Point Typical Performance[1] in Time		Performance in Time[2] (90%Confidence)	
			MTBF [1]	Failure Rate (%/1K Hours)	MTBF [2]	Failure Rate (%/1K Hours)
30	85	105	3,340,000	0.030 %	1,451,000	0.069 %
	75	95	4,782,000	0.021 %	2,077,000	0.048 %
	65	85	6,983,000	0.014 %	3,033,000	0.033 %
	55	75	10,423,000	0.010 %	4,527,000	0.022 %
	45	65	15,930,000	0.006 %	6,919,000	0.014 %
	35	55	24,986,000	0.004 %	10,852,000	0.009 %
	25	45	40,313,000	0.002 %	17,509,000	0.006 %

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 does not emit light.

Example of Failure Rate Calculation:

Assume a device operating 8 hours/day, 5 days a 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:

(0.010%/1K hours) x 0.25 x (8760 hours/year) = 0.022% per year

Similarly, 90% confidence level failure rate per year at 55°C:

(0.022%/1K hours) x 0.25 x (8760 hours/year) = 0.048% per year

Table 3. Environmental Tests

Test Name	Reference	Test Conditions	Units Tested	Units Failed
Infra-red solder Re-flow	HP application note 1028	Re-flow at 235°C Peak, above 185°C for 90 sec. max.	1,912	0
Solder Heat Resistance	MIL-STD-883 Method 2003	Sn 60, Pb 40, solder at 260°C for 5 seconds	3,596	0
Temperature Cycle	MIL-STD-883 Method 1010	-55°C to 100°C, 15 min. dwell, 5 min. transfer 20 cycles 500 cycles	 8308 8308	 0 0
Humidity Life	JIS C 7021 Method B-11 condition C	85°C, 85 % RH, 10 mA, 1000 hours	1,680	0
Humidity Life	JIS C 7021 Method B-11 condition C	85°C, 85 % RH, 30 mA, 1000 hours	112	0
Humidity Life	JIS C 7021 Method B-11 condition C	85°C, 85 % RH, 20 mA, 1000 hours	112	0
Power Temperature Cycle	Automotive specs.	-40°C to 85°C, 15 min. dwell, 5 min. transfer, 20 mA, 5 mins. On/Off 20 cycles 500 cycles	 336 336	 0 0
Corrosion Salt Atmosphere	MIL-STD-883 Method 1009	35°C, 24 hours	38	0

Table 4. Mechanical Tests

Test Name	Reference	Test Conditions	Units Tested	Units Failed
Mechanical Shock	MIL-STD-883 Method 2002	3 shocks each X1, X2, Y1, Y2, Z1, Z2 axis, 3000 g, 0.3msec. pulse	60	0
Vibration Variable Frequency	MIL-STD-883 Method 2007	4 cycles, 4 minute each X1, Y1, Y2 axis at 20 g minimum, 20 to 2000 Hz	60	0
Vibration Fatigue	MIL-STD-883 Method 2005	32 ± 8 hours each X, Y, Z axis at 20 g minimum, 96 hours total	60	0

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Data subject to change.

Obsoletes 5962-9790E

5968-7069E (9/99)