HEWLETT® PACKARD

Subminiature InGaN Blue Lamps

Reliability Data

HLMP-PB00
HLMP-QB00

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)
InGaN Blue	T_A = 25°C, I_F = 30 mA	672,000	672	0	672,000	<0.149
InGaN Blue	T_A = 85°C, I_F = 30 mA	168,000	168	0	168,000	<0.595
InGaN Blue	T_A = 100°C, I_F = 10 mA	168,000	168	0	168,000	<0.595
InGaN Blue	T_A = -40°C, I_F = 30 mA	168,000	168	0	168,000	<0.595
InGaN Blue	T_A = -55°C, I_F = 30 mA	168,000	168	0	168,000	<0.595

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 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 MTBF[1]	Point Typical Performance[1] in Time Failure Rate (%/1K Hours)	Performance in Time[2] (90%Confidence) MTBF[2]	Performance in Time[2] (90%Confidence) Failure Rate (%/1K Hours)
30	85	118	168,000	0.595	73,000	1.371
	75	108	235,000	0.426	102,000	0.980
	65	98	334,000	0.299	145,000	0.689
	55	88	485,000	0.206	211,000	0.475
	45	78	719,000	0.139	312,000	0.320
	35	68	1,091,000	0.092	474,000	0.211
	25	58	1,698,000	0.059	737,000	0.136

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 or maximum % Iv degradation is more than 50%.
4. Calculated from data generated at 85°C biased at 30 mA.

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 85°C ambient temperature is:

(0.595%/1K hours) x 0.25 x (8760 hours/year) = 1.303% per year

Similarly, 90% confidence level failure rate per year at 85°C:

(1.371%/1K hours) x 0.25 x (8760 hours/year) = 3.002% 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	a) 2x IR profile at 240±5°C for 10 sec. b) -55°C to 100°C, 15/5 min. dwell/transfer 20X 100X 500X	 2304 2304 2304	 0 0 0
Temperature Cycle	1010	Method A-4	a) CECC profile at 260±5°C for 10 sec. b) -55°C to 100°C, 15/5 min. dwell/transfer 20X 100X 500X	 2304 2304 2304	 0 0 0
High Temp. Storage	Automotive specs.	Automotive specs.	a) CECC IR profile at 260±5°C for 10s b) 110°C 1000 hrs	168	0
Pulse Test	HP Req.	HP Req.	a) IR profile at 240±5°C for 10s. b) 25°C, 1 khz, 90 mA peak, 33% DF 500 hrs	168	0
Humidity Life		Method B-11 condition C	a) IR profile 240±5°C for 10s b) 85°C, 85% RH, 10 mA 1000 hrs	168	0
Humidity Life		Method B-11 condition C	a) IR profile at 240±5°C for 10s b) 85°C, 85% RH, 5V RB 1000 hrs	48	0
Power Temperature Cycle	Automotive specs.	Automotive specs.	a) IR profile at 240±5°C for 10 sec. b) -40°C to 85°C, 18 min dwell, 42 min. transfer, 20 mA, 5 min. on/off 20X 100X 300X	 168 168 168	 0 0 0
Power Temperature Cycle	Automotive specs.	Automotive specs.	a) IR profile at 240±5°C for 10 sec. b) -40°C to 85°C, 15 min dwell/transfer, 20 mA, 5 min. on/off 20X 100X 500X 1000X	 168 168 168 168	 0 0 0 0
Thermal shock	HP Req.	Automotive specs.	a) CECC IR profile at 260±5°C for 10 sec. b) -40°C to 110°C, 30 min. dwell, <5 sec. transfer 20X 100X	 168 168	 0 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, 0.3 msec. 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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