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Innovating the HP Way

T-1¾ (5 mm) InGaN Blue LEDs

Reliability Data

HLMP-CB15/16
HLMP-CB30/31

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.

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.

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)**
InGaN Blue	T_A = 25°C, I_F = 30 mA	224,000	224	0	224,000	0.446
InGaN Blue	T_A = 55°C, I_F = 30 mA	308,000	252	0	308,000	0.325
InGaN Blue	T_A = -40°C, I_F = 30 mA	224,000	224	0	224,000	0.446

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 = 30 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)**
+55	+103	308,000	0.325	79,000	1.263
+45	+93	443,000	0.226	114,000	0.879
+35	+83	649,000	0.154	167,000	0.599
+25	+73	973,000	0.103	230,000	0.400

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 30 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:

(0.446% / 1K hours) x 0.25 x (8760 hours/year) = 0.97% per year

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

(1.03% / 1K hours) x 0.25 x (8760 hours/year) = 2.26% 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	-40°C to +120°C, 30 min. dwell, 5 minute transfer, 500 cycles	1,151	0
Autoinsertion, Wave Solder and Temperature Cycle	1010	Method A-4	A/I, IR exposure (130°C to 150°C for 90 to 120 sec.), Wave solder (250°C ±10°C for 5 sec.) and TMCL (-40°C to 120°C; 30 min. dwell, 5 min. transfer) for 200 cycles	1,152	
Resistance to Soldering Heat	2003	Method A-1 Condition A	260°C for 10 sec.	112	0
Resistance to Soldering Heat	2003	Method A-1 Condition A	260°C for 5 sec./2x dip.	1,152	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
Continuous Energization	1005 Cond. B	JIS C 7035 Append. 3	25°C @ 100 mA pk, 100 Hz, 10% D/F for 1,000 hours	56	
High Temp. Storage	1005	Method B-10	120°C for 1,000 hours	112	0
Temperature Shock	Agilent Req.		-30°C to 100°C, 30 min. dwell and <20 second transfer, 200 cycles	112	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, 300 cycles	224	0
Humidity Life	Agilent Req.	Agilent Req.	85°C, 85% RH, 10 mA, 1000 hours	224	0
Temperature Humidity Cycle	1004	Method A-5 Method II	-10°C to 65°C, 85-98% RH, 20 cycles, 24 hours/cycle	112	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.	22	0
ESD	3015.7	EIAJ ED-4701	HB Model Class 1 (<1,999 V) and Machine Model (<100 V)	N/A	N/A
Moisture Resistance	N/A	Method B-11 Cond. B	60°C, 90-95% RH, 1,000 hours. Performed 1,000 hours	224	0

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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	100 G, 6 msec, 1/2-sine wave, in 6 directions, 3 times/direction	112	0
Vibration Fixed Frequency	2005, Cond. A	N/A	60 Hz, 20 G, 3 directions, 96 hours	30	0
Vibration Variable Frequency	2007	Method A-10 Condition B	20 - 500 Hz, 10 G, log sweep, 3 directions, 6 hrs	30	0
Termination Strength	2004	Method A-11 Tests I and III	10 N. load for 10 sec. and 2x 5 N. load on lead with ±90° bend	60	0

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Data subject to change.

Obsoletes 5966-0307E
5988-0339EN (10/00)