Agilent Technologies
Innovating the HP Way

High Power T-1 (3 mm), T-1 3/4 (5 mm) and Rectangular AS/TS AlGaAs Plastic Lamps

Reliability Data

HLMP-C10X, C11X, KXXX, R1XX, D1XX, S1XX, and 41XX

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**	**MTBF**	**Failure Rate (% /1K Hours)**
AS AlGaAs	T_A = 55°C I_F = 30 mA	4,727,000	1,512	0	4,727,000	0.002
TS AlGaAs	T_A = 55°C I_F = 50 mA	5,572,000	3,668	0	5,572,000	0.002
AS AlGaAs	T_A = -40°C I_F = 30 mA	1,428,000	952	0	1,428,000	0.070
TS AlGaAs	T_A = -40°C I_F = 50 mA	1,708,000	560	0	1,708,000	0.059

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 on the following page using an activation energy of 0.43 eV (reference MIL-HDBK-217).

Table 2A. AS AlGaAs, 55°C @ 30 mA

		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)
+85	+108	1,543,000	0.065	670,000	0.149
+75	+98	2,197,000	0.046	954,000	0.105
+65	+88	2,188,000	0.031	1,385,000	0.072
+55	+78	4,727,000	0.021	2,053,000	0.049
+45	+68	7,172,000	0.014	3,115,000	0.032
+35	+58	11,159,000	0.009	4,846,000	0.021
+25	+48	17,847,000	0.006	7,751,000	0.013

Table 2B. TS AlGaAs, 55°C @ 50 mA

		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	+110	2,718,000	0.037	1,181,000	0.085
+65	+100	3,854,000	0.026	1,674,000	0.060
+55	+90	5,572,000	0.018	2,420,000	0.041
+45	+80	8,225,000	0.012	3,572,000	0.028
+35	+70	12,419,000	0.008	5,394,000	0.019
+25	+60	19,223,000	0.005	8,349,000	0.012

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.

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

For 55°C and 50 mA:
The point failure rate per year (8760 hours) at 75°C ambient temperature is:

(0.037% / 1K hours) x 0.25 x (8760 hours/year) = 0.081% per year

Similarly, 90% confidence level failure rate per year at 75°C:

(0.086% / 1K hours) x 0.25 x (8760 hours/year) = 0.188% per year

Table 3. Environmental Tests

Test Name	MIL-STD-883C Reference	JIS C 7021 Ref.	Test Conditions	Units Tested	Units Failed
Temperature Cycle	1010	Method A-4	-55°C to 120°C; 15 minute dwell, 5 minute transfer, 100 cycles	24,388	5
Resistance to Soldering Heat	2003	Method A-1 Cond. A	260°C for 5 seconds/2x dip	47,488	0
Solderability	2003	Method A-2	230°C for 5 sec. 1 to 1.5 mm from body, 95% solder coverage of immersed area	420	0
Power Temp. Cycle	Agilent Req.	Agilent Req.	-40°C to 85°C; 15 min. dwell, 5 min. transfer @ 20 mA 5 min. on/off 1000 cycles	224	0
Power Temp. Cycle	Agilent Req.	Agilent Req.	-40°C to 85°C; 18 min. dwell, 42 min. transfer @ 30 mA 5 min. on/off 100 cycles	448	0
Humidity Life	Agilent Req.	Agilent Req.	85°C, 85% RH, 20 mA, 1000 hours	1,118	0
Resistance to Solvents	2015	N/A	1. Z Propanol/mineral spirit solution (1:3 by volume). 2. Propylene glycol monomethylether/monoethanolamine/DI water solution (1:1:42 by volume). 3. Semiaquous solvent with a minimum of 60% limonene and Skysol 600.	224	0
ESD		EIAJ ED-4701	Method C-111, Condition A	60	0

Table 4. Mechanical Tests

Test Name	MIL-STD-883C Reference	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	60	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	60	0
Free Drop Test	N/A	Method A-8	Drop from 75 cm 3X	60	0
Termination Strength	2004	Method A-11 Tests I and III	1 kg. load for 30 sec. 5 N. load on lead with ±90° bend	60	0
Constant Acceleration	2001	Method A-9 Condition D	1 min. each 6 directions, 196,000 m/s^2	60	0

Agilent Technologies
Innovating the HP Way

www.semiconductor.agilent.com

Data subject to change.

Obsoletes 5965-9656E
5968-4127E (11/99)