Agilent Technologies
Innovating the HP Way

Double Heterojunction AlGaAs Red Low Current Seven Segment Displays

Reliability Data

HDSP-x100 Series
HDSP-x101 Series

Description

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

Agilent Technologies 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
Test Name	**Stress Test Conditions**	**Total Device Hrs.**	**Units Tested**	**Total Failed [1]**	**Failure Rate (% /1K Hours) [2]**
High Temperature Operating Life	I_F = 15 mA DC T_A = 55°C	435,000	435	0	≤ 0.230

Notes:
1. For purposes of this data sheet, a failure is any device that (a) has V_F greater than 0.5 V over the maximum data sheet specification or (b) has V_R smaller than 3.0 V at 100 μA or (c) degrades in light output more than 75%.
2. Assuming one failure for calculation.

Failure Rate Prediction

The failure rate given is at elevated operating conditions. The failure rate will depend on the junction temperature of the device. Assuming a package thermal resistance of 430°C per watt the calculated temperature rise during testing was approximately 14°C above the ambient temperature. The estimated life at different temperatures is calculated and listed in the following table. Estimations are done using the Arrhenius model with the activation energy of 0.43 eV in reference to the MIL-HDBK-217 for hybrid products.

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:
(0.230% / 1K hours) x 0.25 x (8760 hours/year) = 0.500% per year.

Similarly, 90% confidence level failure rate per year at 55°C ambient temperature is:
(0.529% / 1K hours) x 0.25 x (8760 hours/year) = 1.15% per year.

Table 2. Failure Rate Prediction

		Point Typical Performance [3] in Time		Performance in Time [4] (90% Confidence)	
Ambient Temperature (°C)	Junction Temperature (°C)	MTBF [1]	Failure Rate (%/1K Hours)	MTBF [2]	Failure Rate (%/1K Hours)
85	99	134,000	0.746	58,000	1.717
75	89	194,000	0.515	84,000	1.185
65	79	287,000	0.348	125,000	0.801
55	69	435,000	0.230	189,000	0.529
45	59	675,000	0.148	293,000	0.341
35	49	1,077,000	0.093	468,000	0.214
25	39	1,769,000	0.057	768,000	0.130

Notes:
3. The point MTBF (representing a typical MTBF) is simply the total device hours divided by the number of failures. Since no failures occurred during the testing, the point MTBF and failure rate are calculated assuming one failure.
4. This MTBF and failure rate represent the performance level for which there is a 90% probability of the device doing better than the stated value. This confidence level is based on the statistics of the distribution of failures. The assumed distribution is exponential. This particular distribution is commonly used in describing useful life failures. This methodology is based on MIL-STD-690B.

Table 3. Mechanical and Environmental Tests

Test Name	MIL-STD-883C Ref	Test Conditions	Units Tested	Units Failed
Physical Dimensions	2016	Device profile at 20X	197	0
Solderability	2003.3	Sn 60, Pb 40 Solder at 260°C for 5 sec.	536	0
Temperature Cycling	1010.5	-55 to 100°C, 15 min. dwell, 5 min. transfer 20 cycles 100 cycles	536	 0 2 (0.37%)
Moisture Resistance	1004.4	10 days, 90-98% RH, -10 to 65°C, non-operating	392	0
Mechanical Shock	2002.3 (Cond. B)	5 blows each X1, Y1, Y2 axis 1500 G 0.5 msec.	369	0
Vibration Fatigue	2005.1 (Cond. A)	32 ±8 hours each X, Y, Z, 96 hours total, 60 Hz, 20 G min.	190	0
Vibration, Variable Frequency	2007.1 (Cond. A)	3 cycles, 4 min. for each X, Y, Z axis at 20 G. min., 20 to 2000 Hz	190	1 (0.53%)
Constant Acceleration	2001.2 (Cond. D)	1 min. each X1, Y1, Y2 at 20,000 G	189	0
Lead Fatigue	2004.4 (Cond. B2)	3 bends 15 degrees min.	45	0
Terminal Strength	2004.4 (Cond. A)	1 lb. for 30 seconds	149	0
Solvent Resistance	2015.4	Solvents tested: 1/4 Isopropyl Alcohol and 3/4 mineral spirits	45	0
Salt Atmosphere	1009.4	35°C for 24 hrs.	50	0

Note:
5. With the exception of solderability and temperature cycling, all data is generic to seven segment display family.

5954-8454 (11/99)