Reliability Data

Description

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

Avago tests parts at the absolute maximum rated conditions recommended for the device. The actual performance you obtain from Avago 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**	**MTBF**	**Failure Rate (% /1K Hours)**
High Temperature Operating Life	V_{CC} = 5.5 V V_A = V_B = 3.5 V T_A = 150°C[3] Static State	562,312	163	1[1]	562,312	0.178
Temperature Humidity Operating Life	V_{CC} = 5.5 V V_A = V_B = 3.5 V T_A = 85°C RH = 85% Static State	128,000	128	0[2]	128,000	0.781

Note:

1. Failures are defined as a parametric shift beyond the maximum defined by the Technical Data Sheet or as a catastrophic failure of the unit to perform its intended function. The noted failure occurred after 792 hours of HTOL at 150°C. The failure was a catastrophic electrical open on channel A due to a metalization fault in the detector IC.
2. 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.
3. The maximum operating temperature specified for the HEDT-9040 and 9140 product is 140°C. The reliability testing was performed at 150°C in order to verify the reliability at 140°C with a guard band of 10°C.

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.

		Point Typical Performance [2] in Time		Performance in Time [3] (90% Confidence)	
Ambient Temperature (°C)	**Junction Temperature (°C)**	**MTBF**	**Failure Rate (%/1K Hours)**	**MTBF [4]**	**Failure Rate (%/1K Hours)**
+150	+160	562,000	0.178	145,000	0.692
+140	+150	738,000	0.135	190,000	0.527
+130	+140	982,000	0.102	253,000	0.396
+120	+130	1,326,000	0.075	341,000	0.293
+110	+120	1,817,000	0.055	467,000	0.214
+100	+110	2,531,000	0.040	651,000	0.154
+90	+100	3,589,000	0.028	923,000	0.108
+70	+80	7,659,000	0.013	1,969,000	0.051
+50	+60	17,901,000	0.006	4,602,000	0.022
+30	+40	46,632,000	0.002	11,989,000	0.008

Notes:
4. 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.

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) = 0.24

The point failure rate per year (8760 hours) at 120°C ambient temperature is:
(0.075% / 1K hours) x 0.24 x (8760 hours/year) = 0.158% per year

Similarly, 90% confidence level failure rate per year at 120°C:
(0.293% / 1K hours) x 0.24 x (8760 hours/year) = 0.616% per year

Table 3. Environmental Tests

Test Name	MIL-STD-883C Reference	Test Conditions	Units Tested	Units Failed
Temperature Cycle	1010	-40°C to +150°C, 15 min. transfer, 300 cycles	75	0
Temperature Cycle Operating Life	—	-40°C to +150°C, Biased 100 cycles	112	0

Table 4. Mechanical Tests

Test Name	MIL-STD-883C Reference	Test Conditions	Units Tested	Units Failed
Mechanical Shock/ Temperature Cycle	—	-40°C to +150°C, 50 cycles followed by 5 blows; X, Y, Z axes, 1500 g; 0.5 msec.	13	0
Vibration Variable Frequency	2007	5 g 10-60 Hz, 10g 60-500 Hz 1 oct/min., 2.5 hours/axis	13	0

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