

Data Sheet

Description

The following cumulative test results have been obtained from testing performed at Avago Technologies in accordance with the latest revision of JEDEC stds. 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.

Failure Rate Prediction

The junction temperature of the device determines the failure rate of semiconductor devices. The relationship between ambient temperature and actual junction temperature is given by the following:

$$T_J(^{\circ}\text{C}) = T_A(^{\circ}\text{C}) + \theta_{JA}P_{AVG}$$

where

T_A = ambient temperature in $^{\circ}\text{C}$

θ_{JA} = thermal resistance of junction-to-ambient in $^{\circ}\text{C}/\text{Watt}$

P_{AVG} = average power dissipated in Watt

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 activation energy of 0.43V.

Table 1. Life Tests

Demonstrated Performance

Colors	Stress Test Conditions	Total Device Hrs	Units Tested	Units Failed	Performance in Time (60% confidence)	
					MTBF ^[1]	Failure Rate (%/1K Hours)
Green/Yellow/Amber/Red/DeepRed/Red Orange	$T_A = +75^{\circ}\text{C}$ $I_f = 20\text{mA}$	84,000	84	0	91700	1.091

Table 2. Reliability Predictions

Demonstrated Performance

Ambient Temperature (°C)	Junction Temperature ^[3] (°C)	Performance in Time (60% Confidence)		Performance in Time (90% Confidence)	
		MTBF ^[1]	Failure Rate ^[2] (%/1K Hours)	MTBF	Failure Rate (%/1K Hours)
85	110	86100	1.161	34300	2.915
80	109	88800	1.126	35400	2.825
75	108	91700	1.091	36500	2.740
70	103	109100	0.917	43400	2.304
65	98	130500	0.766	52000	1.923
60	93	156900	0.637	62400	1.603
55	88	189500	0.528	75400	1.326
50	83	230200	0.434	91600	1.092
45	78	281200	0.356	111900	0.894
40	73	345400	0.290	137500	0.727
35	68	426800	0.234	169900	0.589
30	63	530800	0.188	211300	0.473
25	58	664600	0.150	264500	0.378

Notes:

[1] The 60% or 90% confidence MTBF represents the minimum level of reliability performance which is expected from 60% or 90% of all samples. The confidence level is established based on the chi-square distribution.

[2] Failure rate (%/1K Hours) is $1/\text{MTBF} \times 10^5$, assuming the failures are exponentially distributed.

[3] Data generated based on 55°C, 20mA and $\theta_{JA} = 780^\circ\text{C/W}$

Example of Failure Rate Calculation

Assume a device operating 8 hours/day, 5 days/week. The utilization factor, given 168hours/week is:

$$(8\text{hours/day}) \times (5 \text{ days/week}) / (168 \text{ hours/week}) = 0.25$$

The point failure rate per year (8760 hours) at 75°C ambient temperature is:

$$(1.091\% / 1\text{K hours}) \times 0.25 \times (8760 \text{ hours/year}) = 2.39\% \text{ per year}$$

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

$$(2.74\% / 1\text{K hours}) \times 0.25 \times (8760 \text{ hours/year}) = 6.00\% \text{ per year.}$$

Table 3. Environmental Tests

Test Name	Test Conditions	Units Tested	Units Failed
Temperature Cycle	-55°C/+100°C, 15 mins dwell, 5 mins transfer, 100 cycles	918	0
Low Temperature Operating Life	-40°C, 20mA, 1000hrs	84	0
High Humidity and High Temperature Operating Life	85°C/85%RH, 15mA, 1000hrs	84	0
High Humidity and High Temperature Reverse Bias	85°C/85%RH, 5VRB, 500hrs	84	0
High Humidity and High Temperature Storage Life	85°C/85%RH, 1000hrs	84	0
High Temperature Storage Life	100°C, 1000hrs	84	0
Low Temperature Storage Life	-55°C, 1000hrs	84	0

Table 4. Other Tests

Test Name	Test Conditions	Units Tested	Units Failed
Solder Heat resistance	260°C for 5 secs	66	0
Solderability	8 hrs steam age, Solder dip at 245+/- 5°C, 5 secs	30	0

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