

Reliability Data Sheet

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/JEDEC standards.

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 MTTF 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 0.43eV.

Table 1. Life Tests Demonstrated Performance

Test Name	Stress Test Conditions	Total Device Hrs	Units Tested	Units Failed ^[3]	Point Typical Performance Failure Rate	
					MTTF ^[1] (%/1K Hours)	2.36
High Temperature Operating Life	Ta= 55°C, 28mA	84,000	84	0	42400	2.36

Table 2. Reliability Predictions

Ambient Temperature ($^{\circ}\text{C}$)	Junction Temperature ^[4] ($^{\circ}\text{C}$)	Point Typical Performance in Time ^[1] (60% Confidence)		Performance in Time ^[2] (90% Confidence)	
		MTTF ^[1]	Failure Rate (%/1K Hours)	MTTF ^[2]	Failure Rate (%/1K Hours)
85	90	33200	3.01	17200	5.81
80	89	34500	2.90	18000	5.56
75	88	36000	2.78	18700	5.35
70	87	37500	2.67	19500	5.13
65	86	39000	2.56	20300	4.93
60	85	40700	2.46	21100	4.74
55	84	42400	2.36	22000	4.55
50	83	44200	2.26	23000	4.35
45	82	46100	2.17	24000	4.17
40	81	48100	2.08	25000	4.00
35	80	50200	1.99	26100	3.83
30	79	52400	1.91	27200	3.68
25	78	54700	1.83	28400	3.52

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 $1/MTBF \times 10^5$, assuming the failures are exponentially distributed.
3. Failure criteria: open, short, dim or parametric failure.
4. Junction temperature is calculated based on $\theta_{JA} = 500^{\circ}C/W$.

Example of Failure Rate Calculation

Assume a device operating 8 hours/day, 5 days/week. The utilization factor, given 168 hours/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 55°C ambient temperature is:

$$(2.36\% / 1K \text{ hours}) \times (0.25) \times (8760 \text{ hours/year}) = 5.17\% \text{ per year}$$

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

$$(4.55\% / 1K \text{ hours}) \times (0.25) \times (8760 \text{ hours/year}) = 9.96\% \text{ per year}$$

Table 2. Environmental Tests

Test Name	MIL-STD/JEDEC Reference	Test Conditions	Units Tested	Units Failed
Temperature Cycle	JESDA104	-40°C/85°C, 15 min dwell, 5 min transfer, 100 cycles	684	0
Temperature Humidity Operating Life	JESDA101	Ta= 85°C, RH = 85% RH, If= 5mA, 500hrs	84	0
Temperature Humidity Storage Life	Avago requirement	Ta= 85°C, RH = 85% RH, 500hrs	84	0

Table 3. Mechanical Tests

Test Name	MIL-STD/JEDEC Reference	Test Conditions	Units Tested	Units Failed
Resistance to Solder heat	Avago requirement	solder iron test 350°C, 5 sec, 3x soldering	10	0
Mechanical shock	JESDB104	5 shocks each X1, X2, Y1, Y2, Z1, Z2, 1500G, 0.5msec pulse	30	0

For product information and a complete list of distributors, please go to our web site: www.avagotech.com