

AEDR-8400-140 and AEDR-8400-142

Reflective Surface Mount Optical Encoder



Reliability Data Sheet

Description

The following cumulative test results have been obtained from testing performed at Avago Technologies Malaysia in accordance with the latest revisions of JEDEC Standard. 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 failure rate of semiconductor devices is determined by the junction temperature of the device. The relationship between ambient 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 an activation energy of 0.43eV (reference MIL-HDBK-217).

Table 1. Life Tests

Demonstrated Performance

Test Name	Stress Test Conditions	Total Device Hours	Units Tested	Total Failed	Point Typical Performance	
					MTTF	Failure Rate (%/1 K Hours)
High Temperature Operating Life	$V_{CC}=3.0\text{V}, T_A=85^{\circ}\text{C}, 1500\text{hours}$	45,000	30	0	49,180	2.03

Table 2.

Ambient Temperature ($^{\circ}\text{C}$)	Junction Temperature ($^{\circ}\text{C}$)	Point Typical Performance ^[1] in Time		Performance in Time ^[2] (90% Confidence)	
		MTTF ^[1]	Failure Rate (%/1K Hours)	MTTF ^[2]	Failure Rate (%/1K Hours)
85	89.7	49,180	2.03	19,520	5.12
75	79.7	72,640	1.38	28,840	3.47
65	69.7	109,800	0.91	43,580	2.29
55	59.7	170,000	0.59	67,500	1.48
45	49.7	270,700	0.37	107,400	0.93
35	39.7	443,800	0.23	176,200	0.57
25	29.7	751,900	0.13	298,500	0.34



Notes:

1. The point typical MTTF (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 MTTF 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.
3. Failures are catastrophic or parametric. Catastrophic failures are open, short, no logic output, no dynamic parameters while parametric failures are failures to meet an electrical characteristic as specified in product catalog such as output voltage, duty or state errors.

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:

$$(0.59\% / 1\text{K hours}) \times 0.25 \times (8760 \text{ hours/year}) = 1.29\% \text{ per year}$$

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

$$(1.48\% / 1\text{K hours}) \times 0.25 \times (8760 \text{ hours/year}) = 3.24\% \text{ per year}$$

Table 3. Environmental Tests

Test Name	Test Conditions	Units Tested	Units Failed
Temperature Cycle	-40°C to 85°C, 15min dwell time, 5 min transfer, 1000 cycles	30	0
Wet High Temperature Storage life	T _A =85°C, RH=85%, 1000 hours	30	0

Table 4. Electrical Tests

Test Name	Reference	Test Conditions	Units Tested	Units Failed
ESD- Human Body Model	HBM-JESD22-A114D	Up to 4kV applied to all pins versus ground	9	0
ESD- Machine Model	MM-JESD22-A115-A	Up to 300V applied to all pins versus ground	9	0

Table 5. Mechanical and Vibration shock

Test Name	Test Conditions	Units Tested	Units Failed
Mechanical Shock	15,20,30g 11ms, 5 successive shocks in each direction of 3 perpendicular axes of units	15	Pass
Vibration Shock	15,25,30g 20-2kHz, 10 cycles for each g level.	15	Pass

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