AEDB-9140 Series

Motion Sensing Products Optical Encoder Modules

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 MIL-STD-883. Avago Technologies tests parts at the absolute maximum rated conditions recommended for the device. The actual performance you obtain from Avago Technologies 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 temperature and actual junction temperature is given by the following:

$T_J(°C) = T_A(°C) + \theta_{JA} P_{AVG}$

where:

T_A = ambient temperature in °C

θ_{JA} = thermal resistance of junction-to-ambient in °C/Watt

P_{AVG} = average power dissipated in 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 table 2 using an activation energy of 0.43eV (reference MIL-HDBK-217).

Table 1. Life Tests Demonstrated Performance

					Point Typical Performance	
Test Name	**Stress Test Condition**	**Total Device Hours**	**Units Tested**	**Total Failed**	**MTTF**	**Failure Rate (%/1k Hours)**
High Temperature Operating Life	V_{cc}=5.5V T_A=85°C 1000hours	75,000	75	0	75,000	1.33
Low Temperature Operating Life	V_{cc}=5.5V T_A=-40°C 1000hours	75,000	75	0	75,000	1.33
Wet High Temperature Operating Life	V_{cc}=5.5V T_A=85°C Rh=85% 1000hours	75,000	75	0	75,000	1.33

Table 2.

		Point Typical Performance[1] in Time		Performance in Time[2] (90% Confidence)	
Ambient Temperature(°C)	**Junction Temperature(°C)**	**MTTL(1)**	**Failure Rate (% / 1K Hours)**	**MTTF(2)**	**Failure Rate (% / 1K Hours)**
85	138	81,970	1.22	32,540	3.07
75	128	111,000	0.90	44,040	2.27
65	118	152,500	0.66	60,550	1.65
55	108	213,200	0.47	84,640	1.18
45	98	303,500	0.33	120,500	0.83
35	88	440,500	0.23	174,900	0.57
25	78	653,100	0.15	259,300	0.39

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. Refer to MIL-STD-690B for details on this methodology.
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 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:

(0.47% / 1K hours) x 0.25 X (8760 hours/year) = 1.03 % per year

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

(1.18%/1K hours) X 0.25 X (8760 hours/year) = 2.59% per year

Table 3. Environmental Tests

Test Name	Test Conditions	Units Tested	Units Failed
Temperature Cycle	-40'C to 85'C, 15 min. dwell 5 min. transfer.		
	100 cycles	75	0
	1000 cycles	75	0
High Temperature Storage Life	T_A=85'C 1000hours	25	0

Table 4. Mechanical Tests

Test Name	Test Conditions	Units Tested	Units Failed
VibrationTest	IEC 68-2-21 50Hz-2kHz, 15,25,30g, 10cycles	9	0
Mechanical Shock Test	IEC 68-2-27 15,20, 30g, 11ms, 1000 shock	9	0

Table 5. Electrical Tests

Test Name	Test Conditions	Units Tested	Units Failed
ESD (Human Body Model)	JESD22-A114 Up to 2kV applied to all pins versus ground	9	0
ESD (Machine Model)	JESD22-A115 Up to 200V applied to all pins versus ground	9	0

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

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