AEDS-96XX

Optical Encoder Modules

AVAGO TECHNOLOGIES

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 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 temperature and acceleration actual junction temperature is given by the following:

$T_J(^oC) = T_A(^oC) + \theta_{JA} P_{AVG}$

where

T_A = ambient temperature in ^oC

θ_{JA} = thermal resistance of junction-to-ambient in ^oC/Watt

P_{AVG} = average power dissipated in Watt

The estimated MTBF and failure rate at temperatures lower than the actual stress temperature can be by using an Arrhenius model for temperature. Results of such calculations are shown in the table below using an activation energy of 0.72eV (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	Vcc=3.5V I led=20mA T_A=85°C 1000hours	150,000	150	0	150,000	0.06
High Temperature High Humidity Operating LIfe	Vcc=3.5V I led=20mA T_A=85°C Rh=85% 1000hours	150,000	150	0	150,000	0.06

Table 2.

Ambient Temperature(°C)	Junction Temperature (°C)	Point Typical Performance[1] in Time MTTF(1)	Failure Rate (% / 1K Hours)	Performance in Time[2] (90% Confidence) MTTF(2)	Failure Rate (% /1K Hours)
85	93	150000	0.667	65000	1.538
75	83	285000	0.351	123000	0.813
65	73	561,000	0.178	243,000	0.412
55	63	1,512,000	0.066	499,600	0.200
45	53	2,469,000	0.041	1,071,000	0.093
35	43	5,557,000	0.018	2,411,000	0.041
25	33	13,190,000	0.008	5,721,000	0.017

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 55º C ambient temperature is:

(0.066% / 1K hours) x 0.25 X (8760 hours/year) = 0.145% per year

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

(0.200% / 1K hours) X 0.25 X (8760 hours/year) = 0.438% per year

Table 3. Environmental Tests

Test Name	Reference	Test Conditions	Units Tested	Units Failed
Temperature Cycle	MIL-STD_883 Method 1010	-40°C to 85°C, 15 min. dwell 5 min. transfer. 100 cycles 500 cycles 1000 cycles	 150 150 150	 0 0 0
Resistance to Soldering Heat	MIL-STD_883 Method 2003	260°C peak for 5 sec, 1000 temperature cycles @ -40°C to 85°C	30	0
High Temperature Storage Life	AvagoReq.	T_A= +85°C 1000 hours	231	0
Low Temperature Operating Life	AvagoReq.	T_A= -20°C 1000 hours	84	0
Temperature Humidity Storage Life	AvagoReq.	T_A=85°C Rh=85% 1000hours	150	0
ESD - Human Body Model	MIL-STD_883 Method 3015.2	1.5K ohms, 100pf, 5 positive and 5 negative discharges per pin. Vz= 2.0KV	45	0

Table 4 Mechanical Tests

Test Name	Reference	Test Conditions	Units Tested	Units Failed
Mechanical Shock Test	MIL-STD_883 Method 2002	5 blows; X,Y,Z axes, 1500g, 0.5 msec.	22	0
Vibration Variable Frequency	MIL-STD_883 Method 2007	20g, 5-2000Hz, 6 hours	22	0
Lead Fatique	MIL-STD_883 Method 2004 Cond A	3 bends, 90	22	0
Termination Strength	MIL-STD_883 Method 2004 Cond B	1 lb. For 30 seconds	22	0

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