HEWLETT PACKARD

Small Optical Encoder Modules

Reliability Data

HEDS-9700 Series

Description

The following cumulative test results have been obtained from testing performed at Hewlett-Packard Optoelectronics Division in accordance with the latest revision of MIL- STD-883.

Hewlett-Packard tests parts at the absolute maximum rated conditions recommended for the device. The actual performance you obtain from HP parts depends on the electrical and environmental characteristics of your application but will probably be better than the performance outlined in Table 1.

Table 1. Life Tests

Demonstrated Performance

					Point Typical Performance	
Test Name	**Stress Test Conditions**	**Total Device Hrs.**	**Units Tested**	**Total Failed[3]**	**MTBF**	**Failure Rate (% /1K Hours)**
High Temperature Operating Life	V_{CC} = 5.5 V, $V_A = V_B$ = 3.5 V T_A = 85°C Static State	1,025,000	1,025	2	512,500	0.195
Temperature Humidity Operating Life	V_{CC} = 5.5 V $V_A = V_B$ = 3.5 V T_A = 85°C RH = 85% Static State	1,012,000	1,012	13	77,846	1.285

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 watts

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 on the following page using an activation energy of 0.43 eV (reference MIL-HDBK-217).

Table 2.

		Point Typical Performance [1] in Time		Performance in Time [2] (90% Confidence)	
Ambient Temperature (°C)	Junction Temperature (°C)	MTBF [1]	Failure Rate (%/1K Hours)	MTBF [2]	Failure Rate (%/1K Hours)
+85	+95	513,000	0.195	193,000	0.519
+75	+85	748,000	0.134	281,000	0.356
+65	+75	1,117,000	0.090	420,000	0.238
+55	+65	1,707,000	0.059	642,000	0.156
+45	+55	2,678,000	0.037	1,006,000	0.099
+35	+45	4,321,000	0.023	1,624,000	0.062
+25	+35	7,192,000	0.014	2,702,000	0.037

Notes:

1. The point typical MTBF (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 MTBF 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:

(0.059% / 1K hours) x 0.25 x (8760 hours/year) = 0.129% per year

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

(0.156% / 1K hours) x 0.25 x (8760 hours/year) = 0.342% per year

Table 3. Environmental Tests

Test Name	MIL-STD-883C Reference	Test Conditions	Units Tested	Units Failed
Temperature Cycle	1010	-40°C to +85°C, 15 minute dwell, 5 minute transfer, 20 cycles 200 cycles 500 cycles	 12,308 1,984 1,868	 1 0 15
Solder Heat Resistance	2003	Sn/Pb 60/40 Solder; 260°C peak; 10 sec., 20 temp cycles @ -40°C to 85°C	22	0
Resistance to Solvents[4]	2015	3 immersions, 1 minute each, brush after solvent	22	0

Table 4. Mechanical Tests

Test Name	MIL-STD-883C Reference	Test Conditions	Units Tested	Units Failed
Mechanical Shock	2002	5 blows; X, Y, Z axes, 1500 g, 0.5 msec.	22	0
Vibration Variable Frequency	2007	20 g, 5-2000 Hz, 6 hours	22	0
Terminal Strength	2004 Condition A	22.5 N; 5 seconds	22	0
Lead Fatigue	2004, Cond. B	3 bends, 90°	22	0

Table 5. Electrical Tests

Test Name	MIL-STD-883C Reference	Test Conditions	Units Tested	Units Failed
ESD	3015.2	1.5 KΩ, 100 pF, ±4,000 volts, 3 pulses/pin, one pin biased, all others grounded	10	0

Notes:
4. This test is for marking only, not for device functionality.

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Data Subject to Change

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