Surface Mount PIN Diodes

Reliability Data

HPND-00XX
HSMP-38XA
HSMP-38XX
HSMP-48XX

Description

The following cumulative test results have been obtained from testing performed at Hewlett-Packard in accordance with the latest revision of MIL-STD-750. Data was gathered from the product qualification, reliability monitor, and engineering evaluation.

For the purpose of this reliability data sheet, a failure is any part which fails to meet the electrical and/or mechanical specification listed in this catalog.

1. Life Test

A. Demonstrated Performance

Test	Test Conditions	Units Tested	Total Device Hours	Total Failed	Failure Rate %/1K Hours
High Temp. Rev. Bias (HTRB)	$V_R = 80\% V_{BR}, T_A = 150°C$	1,382	1,385,756	4	0.29
Operating Life (O.L.)	$T_A = R.T., P_{FM} = $ Max. Rated Power, $V_R = 80\% V_{BR}$, 60 Hz	2,162	2,084,325	0	0
High Temp. Storage (HTS)	$T_A = 150°C$	505	511,390	0	0

B. Failure Rate Prediction

The failure rate will depend on the junction temperature of the device. The estimated life at different temperatures is calculated using the Arrhenius plot with activation energy of 1.2 eV and is listed in the following table.

Junction Temp. T_J** (°C)	Point[1]		90% Confidence Level[2]	
	MTTF* (Hours)	FIT[3]	MTTF (Hours)	FIT[3]
150	3.5×10^7	28.6	1.5×10^7	66.7
130	2.0×10^8	5.0	8.7×10^7	11.5
110	1.5×10^9	0.67	6.5×10^8	1.5
90	1.0×10^{10}	0.10	4.3×10^9	0.23
75	1.0×10^{11}	0.01	4.3×10^{10}	0.023
50	2.0×10^{12}	0.0005	8.7×10^{11}	0.0011

*MTTF data collected in Hermetic Package and Plastic Packages.

** T_J was calculated using a θ_{JC} of 500°C/W.

Notes:

1. The point MTTF is simply the total device hours divided by the number of failures.
2. The MTTF and failure rate represent the performance level for which there is a 90% probability of the device doing better than the stated value. The confidence level is based on the statistics of failure distribution. The assumed distribution is exponential. This particular distribution is commonly used in describing useful life failures.
3. FIT is defined as Failure in Time, or specifically, failures per billion hours. The relationship between MTTF and FIT is as follows: $FIT = 10^9/(MTTF)$.

C. Example of Failure Rate Calculation

At 50°C with a device operating 8 hours a day, 5 days a week, the percent utilization is:

$$\% \text{ Utilization} = 8 \text{ hrs/day} \times 5 \text{ days/wk}) \div 168 \text{ hrs/wk} = 25\%$$

Then the point failure rate per year is:

$$(7.7 \times 10^{-12}/\text{hr}) \times (25\%) \times (8760 \text{ hrs/yr}) = 1.69 \times 10^{-6} \% \text{ per year.}$$

Likewise, the 90% confidence level failure rate per year is:

$$(1.8 \times 10^{-11}/\text{hr}) \times (25\%) \times (8760 \text{ hrs/yr}) = 3.94 \times 10^{-6} \% \text{ per year.}$$

2. Environmental and Mechanical Tests

Test Name	MIL-STD-750 Reference	Test Conditions	Units Tested	Total Failed
Solderability	2026	235°C, 5 seconds	746	0
Solder Heat	2031	260°C, 10 seconds	382	0
Resistance to Solvents	1022	4 Solvent Groups	332	0
Autoclave	HP GSS 12-109	121°C, 15 PSIG, 96 hrs.	2,064	10
Moisture Resistance	HP GSS 12-107, Method B	85°C/85% RH, 1000 hrs.	405	0
Thermal Shock	1056	-65/+150°C, 5 min. dwell, 200 cycles	1,447	2
Temperature Cycle	1051	-65/+150°C, 10 min. dwell, 200 cycles	1,209	1
Lead Integrity		2.0 pounds minimum	140	0

3. Flammability Test
(MIL-STD-202, Method 111):

Meets Needle Flame Test per UL Category D (Flaming Time < 3 sec.) under material classifcation 94V0.

4. DOD-HDBK-1686 ESD Classification:

The PIN Diodes covered in this Reliability Data Sheet are Class I, with the following exceptions:

HPND-0002	Class II
HSMP-381X	Class II
HSMP-381A	Class II
HSMP-4810	Class II