HEWLETT® PACKARD

Silicon Bipolar Transistors

Reliability Data

HBFP-0405
HBFP-0420
HBFP-0450

Description

The following cumulative test results have been obtained by Hewlett-Packard from process and product qualification, reliability monitor, and engineering evaluation tests. For the purpose of this reliability data sheet, a failure is any part which does not meet the relevant Hewlett-Packard specification following the reliability tests.

1.0 Life Test

A. Demonstrated Performance

Test Name	Test Conditions	Units Tested	Total Device Hrs.	Total Failed
High Temperature Operating Life (O.L.)	T_J = 150°C V_{CE} = 2 V, I_C = 20 mA	155	301,000	0
High Temperature Reverse Bias (HTRB)	T_J = 150°C, V_{cbo} = 12 V	156	156,000	0

B. Failure Rate Prediction

Point MTTF is simply the total device hours divided by the number of failures. Since no failure was observed, an assumption was made that one unit failed. The assumed distribution is exponential and is commonly used in describing useful life failures. FIT is defined as failures in time, or specifically failures per billion hours. The relationship between MTTF and FIT is as follows: FIT = 10^9/MTTF. The failure rate will depend on the junction temperature of the device. The estimated life at different temperatures is calculated using activation energy of 1.0 eV.

Junction Temp. T_J(°C)	Point		90% Confidence Level	
	MTTF (hours)	FIT	MTTF (hours)	FIT
150	3.0×10^5	3322	1.3×10^5	7649
160	5.6×10^6	1709	2.4×10^5	3935
130	1.2×10^6	850	5.2×10^5	1957
120	2.5×10^6	408	1.1×10^6	939
110	5.3×10^6	189	2.3×10^6	435
100	1.2×10^7	84	5.2×10^6	193
90	2.8×10^7	36	1.2×10^7	83
80	7.0×10^7	14	3.0×10^7	32
70	1.8×10^8	5	7.8×10^7	12
60	5.0×10^8	2	2.2×10^8	5
50	1.5×10^9	1	6.5×10^8	2

C. Example of Failure Rate Calculation
At 100°C for a device operating 8 hours a day, 5 days a week, the percent utilization is:

% Utilization = (8 hours/day) x (5 days/week) ÷ 168 hours/week ≅ 25%

Then at 100°C, the point failure rate per year is:

$(8.4 \times 10^{-8}/hr.) \times (25\%) \times (8760\ hours/year) = 1.8 \times 10^{-2}\%$ per year

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

$(1.9 \times 10^{-7}/hr.) \times (25\%) \times (8760\ hours/year) = 4.2 \times 10^{-2}\%$ per year

2.0 Environmental Tests

Test Name	Test Conditions	Duration	Number of Failed/Sample Size
Thermal Shock	-65°C/+150°C, 5 min. dwell	1000 cycles	0/460
Temp Cycling	-65°C/+150°C, 10 min. dwell	2000 cycles 1000 cycles	0/227 0/228
Moisture Resistance (WHTRB)	85°C/ RH 85%, V_{cbo} = 16.0 V	1000 hrs	0/176
Moisture Resistance (WHTOL)	85°C/ RH 85%, V_{ce} = 2 V, 20 mA	2000 hrs	0/156
Autoclave	121°C, 15 psig, 100% RH	96 hrs	0/456
Resistance to Solvents	3 solvent groups	—	0/22
Solderability	245°C, 5 seconds	8 hrs steam aging	0/22

3.0 Electrostatic Discharge

Test Name	Referance	Results
Human Body Model	EIA/JESD22-A114-A	Class 1
Machine Model	EIA/JESD22-A115-A	Class A

Class 1 is ESD voltage level <2000V, Class 2 is voltage level between 2000V and 4000V, Class 3 is voltage level >4000V.

Class A is ESD voltage level <200 V, Class B is voltage level between 200 V and 400 V, Class C is voltage level >400 V.

4.0 Flammability Rating

The device is designed to meet the UL category D

Note:
Preconditioning per JESD22-A113-A class 1, was performed on all the devices before the reliability tests.

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Data subject to change.
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Obsoletes 5968-1409E
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