

ATF-551M4/541M4

Reliability Data Sheet



Description

The ATF-551M4/541M4 Enhancement Mode FETs are fabricated with Avago Technologies new PHEMT C process. This process has been qualified at wafer level and a similar robustness was observed as compared to other PHEMT processes. The ATF-551M4/541M4 was tested at various stress intervals for DC and RF functionality i.e. Vd, Vg, Id, NF, Ga, OIP3 and OP1dB. The data in Table 1 was gathered from the product qualification test results.

Reliability Prediction Model

An exponential cumulative failure function (constant failure rate) was used as the reliability prediction model to predict failure rate and mean time to failure (MTTF) at various temperatures as shown in Table 2. The wearout mechanisms are therefore not considered. The Arrhenius temperature de-rating equation is used. We assume no failure mechanism change between stress and use condi-

tions. Bias and temperature are alterable stresses and must be considered with the thermal resistance of the devices when determining the stress condition. The failure rate will have a direct relationship to the life stress. Using bare PHEMT die, the process was tested to determine an activation energy of 2.2 eV. Confidence intervals are based upon the chi-squared prediction method associated with exponential distribution.

Table 1. Life Tests

Demonstrated Performance

Test Name	Stress Test Conditions	Units Tested	Total Device Hrs.	Units Failed
High Temperature Operating Life	$T_{ch} = 150^{\circ}\text{C}$ DC Bias	72	72,000	0

A failure criterion of ± 0.5 dB for NF/Gain, ± 3.0 dBm for OIP₃ and ± 1.5 dBm for OP1dB

Table 2. Estimates for Various Channel Temperatures

Channel Temperature ($^{\circ}\text{C}$) ^[2]	Point Typical Performance MTTF hours ^[1]	90% Confidence MTTF hours	Point Typical Performance FIT	90% Confidence FIT
150	7.20×10^4	3.12×10^4	13,900	32,000
125	3.17×10^6	1.38×10^6	315	727
100	2.32×10^8	1.01×10^8	4.3	9.9
85	4.06×10^9	1.76×10^9	0.2	0.6

Notes:

1. Point MTTF is simply the total device hours divided by the number of failures. However, in cases for which no failures are observed, the point estimate is calculated under the assumption that one unit failed.
2. Thermal Resistance: ATF-551M4 = 244.6°C/W , ATF-541M4 = 211.72°C/W

Table 3. Product Qualification — Operational Life Test Results

Stress	Conditions	Duration	Failures/number tested
High Temperature Operating Life (HTOL)	3V with channel temperature of 150°C	1000 hours	0/72
WHTOL	85°C/85% RH	1000 hours	0/72

Table 4. Product Qualification — Environment Stress Results^[3]

Stress	Conditions	Duration	Failures/number tested
TMCL	-65/150°C, 10 minutes dwell	500 cycles	0/80
Solderability	Steam age 1 hr, 245°C, 5s	2X	0/165
Solder Heat	85°C/85%RH Reflow, 260°C, 10s	24 hours 3X	0/125

Note:

3. Table 4 is based on MGA-725M4 results.

Table 5A. Electrostatic Discharge (ESD) Test Results: ATF-551M4

ESD Test	Reference	Results
Human Body Model	EIA/JESD22-A114-A	Do not exceed 200 V (Class 1)
Machine Model	EIA/JESD22-A115-A	Do not exceed 25 V (Class A)

Table 5B. Electrostatic Discharge (ESD) Test Results: ATF-541M4

ESD Test	Reference	Results
Human Body Model	EIA/JESD22-A114-A	Do not exceed 300 V (Class 1)
Machine Model	EIA/JESD22-A115-A	Do not exceed 40 V (Class A)

Notes:

Class 1 is ESD voltage level <2000V, Class 2 is voltage level between 2000 and 4000V, Class 3 is voltage level >4000V
Class A is ESD voltage level <200V, Class B is voltage level between 200 and 400V, Class C is voltage level to >400V.

Since the ESD sensitivity level on Machine Model is very low, pre-caution has to be taken as follows:

1. Ensure Faraday cage or conductive shield bag is used when the device is transported from one destination to another.
2. At SMT assembly station, if the static charge is above the device sensitivity level, place an ionizer near to the device for charge neutralization.
3. Personal grounding must be worn at all time when handling devices.

Moisture Sensitivity Classification: Class 1

Preconditioning per JESD22-A113-A class 1, was performed on all devices prior to reliability testing.

Flammability Rating: UL Class 94V-0

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