ACPM-5813

Reliability Data Sheet

Description

This document describes the reliability performance of a fully matched 10-pins surface mount module ACPM-5813 developed for LTE Band-13 and Band-14. It was qualified by similarity based on similar product design, wafer fabrication technology and packaging process. This power amplifier module operates in 777-798 MHz bandwidth and meets stringent LTE (MPR=0dB) linearity requirements up to 27.5dBm output power.

This product is packaged in a standard 3mmx3mm form factor package incorporated with 50ohm input and output matching network where the mechanical test results were leveraged on a representative part, ACPM-5308.

The power amplifier is manufactured on an advanced InGaP HBT (hetero-junction Bipolar Transistor) MMIC (microwave monolithic integrated circuit) technology offering state-of-the-art reliability, temperature stability and ruggedness.

Reliability Prediction Model

An exponential cumulative failure function (constant failure rate) model was used to predict the failure rate and mean time to failure (MTTF). The wear-out mechanism is therefore not considered. The Arrhenius temperature derating equation is used. It is assumed that no failure mechanism changes between stresses and the use conditions. Bias and temperature condition 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 bias life stress. The HBT have been tested to determine the activation energy of 1.58eV and was used to predict the MTTF and FIT rate for the HBT. Confidence intervals are based upon the chi-squared prediction method associated with exponential distribution.

Table 1. Life Prediction:
Demonstrated Performance

Test Name	Stress Test Condition	Total Units Tested	Total Device Hours	No. Of Failed Units
DC-High Temperature Operating Life (DC-HTOL)	Ta=125°C; Vcc=3.4V, Ven=1.8V, Vmode=0V (HP); RF ports into 50 Ω. JESD22-A108	75	37,800	0/75

Table 2. Estimated for Various Channel Temperatures are as follows:

Channel Temp. (°C)	Point Typical Performance MTTF (yrs)	90% Confidence MTTF (yrs)	Point Typical Performance FIT	90% Confidence FIT
125	10.54	4.57	10,828.26	24,959.14
100	231.01	100.22	493.81	1,138.23
85	1,811.91	786.08	62.96	145.12
60	84,731.92	36,760.05	1.35	3.1

Point typical MTTF is simply the total device hours divided by the number of failures. Since no failures were observed, the point estimate is calculated under the assumption that one unit failed. FIT rates shown are relatively high due to the limited device hours at product release.

Table 3. Operating Life Test Results:

Stress	Reference & Conditions	Duration	Failures/ number tested
DC-High Temperature Operating Life (DC-HTOL)	Ta=125°C; Vcc=3.4V, Ven=1.8V, Vmode=0V (HP), RF ports into 50 Ω. JESD22-A108	504 hours	0/75
Temperature Humidity Operating Life (DC-WHTOL)	Ta=85°C/85%RH; (HPM/Off/MPM/Off) Vcc=4.2V, Ven=2.6V/0V, Vmode=2.6V/0V, RF ports into 50 Ω. JESD22-A101	504 hours	0/75

Table 4. Environmental Test Results:

Stress	Reference & Conditions	Duration	Failures/ number tested
High Temperature Storage	Ta=150°C JESD22-A103	504 hours	0/75
Unbiased Highly Accelerated Temperature and Humidity Stress	Ta=130°C/85%RH, 230kPa, No Bias JESD22-A118	96 hours	0/75
Temperature Cycling	Condition B: -55°C/+125°C, 15mins dwell, Air to Air. JESD22-A104	700 cycles	0/75

Table 5. Mechanical Tests Information:

Stress	Reference & Conditions	Duration	Failures/ number tested
Auto Drop Test	Peak acceleration: 1500Gs. Pulse duration: 0.5ms half-sine pulse. JESD22-B111	30 drops	0/60
Cycle Bending	Amplitude 1.0mm, total displacement 2.0mm. Bending rate 80mm per minute.	5x	0/30
Bending Test	Bending up to 5mm with 1mm increment. Maintained in bend state for 5s ± 1s for every 1mm increment. IEC 60068-2-21-Ue1	Every 1mm	0/30
Shear Test	Force = 10N, 60 sec	4 sides	0/30

Note: All mechanical tests are tested on daisy chain device.

Table 6. Thermal Resistance Information:

Stress	Reference & Conditions	Theta Jc
Thermal Resistance	Vcc = 3.4V, Ven = 1.35V, Vmode=0.5V; Pout : 27.5dBm	16.6 °C/W

Table 7. ESD Ratings:

ESD Test	Reference:	Results
Human Body Model	JESD22-A114	1500V (Class 1C)
Machine Model	JESD22-A115	150V (Class A)
Charge Device Model	JESD22-C101	500V (Class III)

HBM

Class 0 is ESD voltage level < 250V, Class 1A is voltage level between 250V and 500V, Class 1B is voltage level between 500V and 1000V, Class 1C is voltage level between 1000V and 2000V, Class 2 is voltage level between 2000V and 4000V, Class 3A is voltage level between 4000V and 8000V, Class 3B is voltage level > 8000V.

MM

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

CDM

Class I is ESD voltage level < 200V, Class II is voltage level between 200V and 500V, Class III is voltage level between 500V and 1000V, Class IV is voltage level >1000V.

Handling precautions

Note: ESD sensitivity levels for Human Body Model, Machine Model and Charge Device Model necessitate the following handling precautions:

1. Ensure Faraday cage or conductive shield is used during transportation processes.
2. If the static charge at SMT assembly station is above device sensitivity level, place an ionizer near to the device for charge neutralization purposes.
3. Personal grounding must be worn at all time when handling the device.

Moisture Sensitivity Classification: Level 3

Preconditioning per JESD22-A113D Level 3 was performed on all devices prior to reliability testing except for ESD classification test and mechanical test.

MSL 3 Preconditioning, Accelerated condition (JESD22-A113D): 125°C HTS for 24hrs + 60°C/60%RH for 40hrs + 3x Pb-free Reflow, 260°C peak.

For product information and a complete list of distributors, please go to our web site: **www.avagotech.com**

AV02-3997EN - February 6, 2013