ACPM-2302, ACPM-5502, ACPM-5702

Reliability Data Sheet

Description

This document describes the reliability performance of a fully matched 10-pin surface mount modules ACPM-2302, ACPM-5502 and ACPM-5702 that operate in 1850 – 1910 MHz bandwidth. Avago Technologies' ACPM-2302 and ACPM-5502 meet stringent UMTS linearity requirements up to 28 dBm output power; while ACPM-5702 meets stringent linearity requirements up to 28 dBm output power for UMTS and 27 dBm output power for LTE (MPR = 0 dB).

This product is packaged in a standard 3.0 mm × 3.0 mm × 0.9 mm MCOB package 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 de-rating 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 1.58 eV 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
RF-High Temperature Operating Life	T_j = 150 °C RF Bias	75	37,800	0/75

Table 2. Estimates for Various Channel Temperatures

Channel Temp. (°C)	Point Typical Performance MTTF (yrs)	90% Confidence MTTF (yrs)	Point Typical Performance FIT	90% Confidence FIT
150	4.31	1.87	26,455.03	60,978.84
125	65.64	28.48	1,737.88	4,005.81
100	1,439.39	624.46	79.25	182.68
85	11,289.53	4,897.84	10.10	23.29
60	527,941.41	229,041.83	0.22	0.50

Point typical MTTF is simply the total device hours divided by the number of failures. As 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
RF High Temperature Operating Life (RF-HTOL)	T_j=150 °C, V_{cc} = 3.4 V, V_{en} = 2.6 V, V_{mode} = 0 V (HP) Middle Frequency, Maximum P_{out} into 50 Ω JESD22-A108	504 hours	0/75
Temperature Humidity Operating Life (DC-WHTOL)	T_a = 85 °C/85% RH Cycle Bias 1 hr/mode (HPM/Off/MPM/Off) V_{cc} = 4.2 V, V_{en} = 2.6/0 V, V_{mode} = 2.6 V/0 V, 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	T_a = 150 °C JESD22-A103	504 hours	0/75
Unbiased Highly Accelerated Temperature and Humidity Stress	T_a = 130 °C/85% RH, 230 kPa, No Bias JESD22-A118	96 hours	0/75
Temperature Cycling	T_a = -55 °C/125 °C, 15 mins 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: 1500 Gs. Pulse duration: 0.5 ms half-sine pulse. JESD22-B111	30 drops	0/60
Cycle Bending	Amplitude 1.0 mm, total displacement 2.0 mm. Bending rate 80 mm per minute.	5×	0/30
Bending Test	Bending up to 5 mm with 1 mm increment. Maintained in bend state for 5 s ± 1 s for every 1 mm increment. IEC 60068-2-21-Ue1	Every 1 mm	0/30
Shear Test	Force = 10 N, 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	V_{cc} = 3.4 V, V_{en} = 1.35 V, V_{mode} = 0.5 V, P_{out}: 28 dBm	13.3 °C/W

Table 7. Electrostatic Discharge (ESD) Ratings

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

HBM

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

MM

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.

CDM

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

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 before reliability testing except for ESD classification test and mechanical test.

MSL 3 Preconditioning, Accelerated condition (JESD22-A113): 125 °C HTS for 24 hrs + 60 °C/60% RH for 40 hrs + 3× Pb-free Reflow, 260 °C peak.

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

AV02-3156EN - April 25, 2014