Reliability Data Sheet

AFEM-9080, AFEM-9086

Multiband Multimode Module

Description

This document describes the reliability performance of the AFEM-9080, AFEM-9086 modules based on a series of reliability tests conducted.

The AFEM-9080, AFEM-9086 are multiband multimode modules that include PAs, Duplexers, ANT switch, bidirectional coupler, and LNA. These modules support UMTS/LTE bands 1, 2/25, 3, 4/66, 34 and 39, and CDMA BC1.These products are designed to support ET (envelope tracking) for FDD bands and TDD bands, and the part can support CA (carrier aggregation) for B1+B3 (AFEM-9080/86) and B25+B66 (AFEM-9086).

ACPM-9080 was qualified by similarity to ACPM-9086, based on similarity in product design, wafer fabrication technology, and packaging process. These products are packaged in a standard 5.5mm × 8.2mm package, where the mechanical tests were performed on a representative daisy chain package part AFEM-9060/66.

Input and output terminals are internally matched to 50Ω. The power amplifier is manufactured on an advanced InGaP HBT technology, offering state-of-the-art reliability, temperature stability, and ruggedness.

Reliability Prediction Model

Failure rate predictions are based on HTOL test results. The prediction uses an exponential cumulative failure function (constant failure rate) as the reliability prediction model to predict failure rate and mean time to failure (MTTF) at various temperatures as shown in Table 2. The wear-out mechanisms are not considered. The Arrhenius temperature de-rating equation is used. Broadcom assumes no failure mechanism change between stresses and use conditions. 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. The failure rate prediction was calculated using activation energy of 1.33eV as a conservative estimate. Confidence intervals are based upon the chi-squared prediction method associated with exponential distribution.

Table 1: Life Prediction: Demonstrated Performance

Test Name	Stress Condition	Total Units Tested	Total Device Hours	Number of Failed Units
High Temperature Operating Life	T_j = 150°C RF Bias	75	37800 hours	0/75

Table 2: Estimated for Various Channel Temperatures

Channel Temp. (°C)	Point Typical Performance MTTF (yrs/failure)	90% Confidence MTTF (yrs)	Point Typical Performance FIT	90% Confidence FIT
150	4.31	1.87	26455.03	60978.84
125	42.67	18.51	2673.76	6163.02
100	573.97	249.01	198.75	458.12
85	3249.79	1409.89	35.10	80.91
60	82706.38	35881.29	1.38	3.18

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: Environmental Test Results

Stress	Conditions	Duration	Failures/ Number Tested
High Temperature Storage	Ta = 150°C JESD22-A103	504 hours	0/75
Unbiased Highly Accelerated Temperature and Humidity Stress	130°C/85%RH, 205kPa, No Bias JESD22-A118	96 hours	0/75
Temperature Cycling	–55°C/+125°C, 15min dwell, air to air, JESD22-A104	700 cycles	0/75

Table 4: Operating Life Tests Results

Stress	Conditions	Duration	Failures/ Number Tested
High Temperature Operating Life (HTOL)	Tj = 150°C, Vbatt = 3.7V,Vcc = 3.4V, RFFE PA CNTRL = HPM, Middle frequency, maximum Pout into 50Ω. JESD22-A108	504 hours	0/75
Temperature Humidity with Bias (THB)	Ta = 85°C/85%RH, Vbatt = 4.8V, Vcc = 4.2V RFFE PA CNTRL = Power down mode, RF ports into 50Ω. JESD22-A101	504 hours	0/75

Table 5: Mechanical Tests Information

Stress	Conditions	Duration	Failures/ Number Tested
Drop Test	Peak acceleration: 1500Gs. Pulse duration: 0.5 ms half-sine pulse. JESD22-B111	30 drops	0/60
Cycle Bending Test	Amplitude 1.0 mm, total displacement 2.0 mm. Bending rate 80 mm per min.	5x	0/30
Shear Test	Force = 10N for 60s, 4 sides separately IEC60068-2-21	60 sec/side	0/30

Table 6: Thermal Resistance Information

Stress	Product	Theta Jc
Thermal Resistance UMTS HB	Vbatt = 3.7V, Vcc = 3.4V; RFFE PA CNTRL= B1 (HPM)	25.8 °C/W
Thermal Resistance UMTS LB	Vbatt = 3.7V, Vcc = 3.4V; REEF PA CNTRL=B3 (HPM)	16.0 °C/W
Thermal Resistance UMTS HB	Vbatt = 3.7V, Vcc = 3.4V; REEF PA CNTRL=B25 (HPM)	19.0 °C/W
Thermal Resistance UMTS HB	Vbatt = 3.7V, Vcc = 3.4V; RFFE PA CNTRL=B39 (HPM)	28.8 °C/W

Table 7: ESD Ratings

ESD Test	Reference	Results
Human Body Model	JS-001	1000V (Class 1C)
Charge Device Model	JESD22-C101	250V (Class II)

HBM

Class 0A is ESD voltage level <125V,
Class 0B is voltage level between 125V and 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.

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

ESD sensitivity levels for Human Body Model and Charge Device Model make the following handling precautions necessary:

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

Moisture Sensitivity Classification: Level 3

Preconditioning per JESD22-A113-D Level 3 was performed on all devices prior to reliability testing except ESD and mechanical tests.

MSL3 preconditioning (JESD22-A113D): 125 C HTSL for 24 hours + 60°C/60% RH for 40 hours + 3XIR reflow, 260°C peak.

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