Reliability Data Sheet



Description

This document describes the reliability performance of AFEM-S106 based on the tests shown on this data sheet. All these parts use the same GaAs RFIC, PCB stack, and packaging assembly so the reliability testing was done on a representative samples from the same family of product.

Avago Technologies AFEM-S106 WiFi FEM includes power amplifier, power detector, and SPDT antenna switch. It is designed for mobile and fixed wireless data applications in the 5.1 to 5.9 GHz frequency ranges. The PA is optimized for IEEE 802.11 a/n WiFi modulation, The PA exhibit flat gain and good match while providing linear power efficiency to meet stringent mask conditions. It also utilizes Avago Technologies proprietary GaAs Enhancementmode pHEMT technology for superior performance across voltage and temperature levels while providing excellent out of band rejection. Various reliability stress tests have been conducted and the results are shown below:

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 pHEMT has been tested to determine the activation energy of 1.58 eV and was used to predict the MTTF and FIT rate for the PHEMT. Confidence intervals are based upon the chi-squared prediction method associated with exponential distribution.

Table 1. Life Prediction:

Demonstrated Performance

Test Name	Stress Test	Total Units	Total Device	No. Of Failed
	Condition	Tested	Hours	Units
RF High Temperature Operating Life ^[1]	Tj=150°C; Vcc=3.3V,Ven =2.9V	75	37,500	0/75

Note 1: Result for AFEM-S106 Leveraged on AFEM-S105 base on similarity in GaAs RFIC, PCB stack, package process and technology.

Channel Temp. (°C)	Point Typical Performance MTTF ^[2] (yrs)	90% Confidence MTTF (yrs)	Point Typical Performance FIT	90% Confidence FIT
150	4.28	1.86	26666.66	61466.66
140	12.22	5.30	9335.82	21519.06
130	36.77	15.95	3102.52	7151.31
120	117.02	50.77	974.83	2246.99
110	395.65	171.65	288.33	664.59
100	1427.96	619.51	79.88	184.14

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

Note 2. 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.



NOTE: THESE DEVICES ARE ESD SENSITIVE THE FOLLOWING PRECAUTIONS ARE STRONGLY RECOMMENDED. ENSURE THAT AN ESD APPROVED CARRIER IS USED WHEN UNITS ARE TRANSPORTED FROM ONE DESTINATION TO ANOTHER PERSONAL GROUNDINGS IS TO BE WORN AT ALL TIMES WHEN HANDLING THESE DEVICES. THE MANUFACTURER ASSUMES NO RESPONSIBILITIES FOR ESD DAMAGE DUE TO IMPROPER STOR-AGE AND HANDLING OF THESE DEVICES.

Table 3. Operating Life Test Results:

Stress	Reference & Conditions	Duration	Failures/ number tested
RF High Temperature Operating Life (HTOL) ^[1]	Tj=150°C; Vcc=3.3V, Ven=2.9V, Pout=16.0dBm, middle frequency: 5.50GHz JESD22-A108C	500 hours	0/75
Wet High Temperature Operating Life (WHTOL)	85°C/85%RH; Vcc=3.3V, Ven =2.9V @ Cycle Bias 1hr on/off EIA/JESD22-A101	500 hours	0/75

Note 1: Result for AFEM-S106 Leveraged on AFEM-S105 base on similarity in GaAs RFIC, PCB stack, package process and technology.

Table 4. Environmental Test Results:

Stress	Reference & Conditions	Duration	Failures/ number tested
Temperature Cycling ^[2]	JESD22-A104 Condition B:-55°C/+125°C, 15mins dwell, 10mins transfer	700 cycles	0/75
High Temperature Storage ^[2]	JESD22-A103 125℃	500 hours	0/75
Wet & High Temperature Storage Life ^[2]	JESD22-A113 85°C.85%RH	500 hours	0/75

Note 2: Result for AFEM-S106 Leveraged on AFEM-S105 base on similarity in GaAs RFIC, PCB stack, package process and technology.

Table 5. Mechanical Tests Information:

Stress	Reference & Conditions	Duration	Failures/ number tested
Drop Test (auto) ^[3]	Peak acceleration: 1500Gs. Pulse duration: 0.5ms half-sine pulse. JESD22-B111	30 drops	0/60
Cycle Bending Test ^[3]	Deflection: ± 1mm, Bending Rate: 80mm/min JESD22-B113	30 cycles	0/20
Shear Test ^[3]	Shear force 10N for 60 sec IEC60068-2-21-Ue3	4-sided	0/20

Note 3: Tested on daisy chain unit.

Table 6. Thermal Resistance Information:

Stress	Product	Theta Jc
Thermal Resistance	Vcc=3.3V, Ven=2.9V	29.8°C/W
	Pout=16.0dBm , Middle frequency: 5.50GHz	

Table 7. Electrostatic Discharge (ESD) Ratings:

ESD Test	Reference:	Results
Human Body Model	JESD22-A114-C	350V (Class 1A)
Machine Model	JESD22-A115-A	50V (Class A)

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.

ESD Sensitivity

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.

MSL 3 Preconditioning, Accelerated condition (JESD22-A113): 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

