

Reliability Data Sheet

Description

This document describes the reliability performance of AFEM-S102 based on the tests shown on this data sheet. All these parts use the same GaAs RFIC, Filter, PCB stack, and packaging assembly so the reliability testing was done on a representative samples from the same family of product.

The AFEM-S102 is a Front End Module used in conjunction with WLAN and Bluetooth solutions in a coexistence application. The front end module consist of a SP3T switch, coupler, coexistence filter, filter matching, and DC blocking capacitors

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 Condition	Total Units Tested	Total Device Hours	No. Of Failed Units
RF-High Temperature Operating Life	Ta = 100°C RF Bias	32	32,000	0/32

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
100	3.65	1.58	31250.00	72031.25
85	28.63	12.42	3984.29	9183.80
70	268.89	116.66	424.25	977.88
60	1338.93	580.88	85.20	196.39
50	7363.78	3194.70	15.49	35.71

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.



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 GROUNDING IS TO BE WORN AT ALL TIMES WHEN HANDLING THESE DEVICES. THE MANUFACTURER ASSUMES NO RESPONSIBILITY FOR ESD DAMAGE DUE TO IMPROPER STORAGE AND HANDLING OF THESE DEVICES.

Table 3. Environmental Test Results:

Stress	Reference & Conditions	Duration	Failures/ number tested
Temperature Cycling	JESD22-A104 : Condition C: -65°C/+150°C, 15mins dwell, 10mins transfer	500 cycles	0/75
High temperature storage	JESD22-A103: Ta= +150°C	1000 hours	0/75
Autoclave	121°C/100%RH, 15psig	96 hours	0/75
Biased HAST	JESD22-A110: 130°C/85%RH, Vcc = 4.7V	96 hrs	0/75
Wet & High Temperature Storage Life	JESD22-A113: 85°C/85%RH	1000 hours	0/75
Solderability	JESD22-B102: Steamage 1hr at +245°C for 5 secs	2x	0/35

Table 4. Operating Life Test Results:

Stress	Reference & Conditions	Duration	Failures/ number tested
RF High Temperature Operating Life	JESD22-A108C: Ta=100°C, Vcc=3.4V, Pout=23.0dBm, middle frequency: 2.450GHz	1000 hours	0/32

Table 5. Mechanical Tests Information:

Stress	Reference & Conditions	Duration	Failures/ number tested
Drop Test (auto) ^[1, 2]	JESD22-B111 Peak acceleration: 1500Gs. Pulse duration: 0.5ms half-sine pulse.	30 drops	0/60
Cycle Bending Test ^[1, 2]	Deflection: ± 1mm, Bending Rate: 80mm/min	75 cycles	0/26
Shear Test ^[1, 2]	Shear force: 10N for 60 secs	4-sided	0/20

Notes:

1. Tested on daisy chain unit.

2. Result for AFEM-S102 Leveraged on AFEM-S105 base on similarity in package process and technology.

Table 6. ESD Ratings:

ESD Test	Reference:	Results
Human Body Model	JESD22-A114-C	300V (Class 1A)
Machine Model	JESD22-A115-A	80V (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-A113D): 125°C HTS for 24hrs + 60°C/60%RH for 40hrs + 3x Pb-free Reflow, 260°C peak.

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