ALM-1612, ALM-GP002 and ALM-GP003

1.575GHz GPS High-Gain Low Noise Amplifier

Reliability Data Sheet

Description

This document describes the reliability performance of ALM-1612/ALM-GP002/ALM-GP003 based on a series of reliability test conducted.

Avago Technologies' ALM-1612/ALM-GP002/ALM-GP003 is a GPS front-end module that combines a low-noise amplifier (LNA) with a GPS FBAR filter. ALM-1612/ALM-GP002/ALM-GP003 is housed in a MCOB 3.3mmx2.1mmx1mm, 4.5mmx2.2mmx1mm and 2.9mmx2.0mmx1mm respectively, operates at 1.575GHz. The LNA uses Avago Technologies' proprietary GaAs Enhancement-mode pHEMT process to achieve high gain with very low noise figure and high linearity. Noise figure distribution is very tightly controlled. A CMOS-compatible shutdown pin is included either for turning the LNA on/off, or for current adjustment. The integrated filter utilizes an Avago Technologies' leading-edge FBAR filter for exceptional rejection at Cell/PCS-Band frequencies. The low noise figure and high gain, coupled with low current consumption make it suitable for use in critical low-power GPS applications or during low-battery situations.

The reliability performance of ALM-GP002/ALM-GP003 was leveraged on ALM-1612 based on same wafer fabrication process and design.

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 is therefore not considered. The Arrhenius temperature de-rating equation is used. Avago Technologies 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. Using bare PHEMT die, the process was tested to determine activation energy of 2.25eV. 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
High Temperature Operating Life	Tj = 150°C DC Bias, Pin	77	38,500	0

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

Channel Temp. (°C)	Point Typical Performance MTTF hours [1]	90% Confidence MTTF hours	Point Typical Performance FIT	90% Confidence FIT
150	3.85×10^4	1.67×10^4	26000	59870
125	1.86×10^6	8.067×10^5	538	1239.6
100	1.51×10^8	6.552×10^7	6.62	15.3
85	2.84×10^9	1.231×10^9	0.35	0.8

1. Point MTTF is simply the total device hours divided by the number of failures. However, in cases for which no failures are observed, the point estimate is calculated under the assumption that one unit failed.

Table 3. Operation Life Tests Results:

Stress	Conditions	Duration	Failures / Number tested
High Temperature Operating Life (RF-HTOL)	Tj=150°C; Vdd = 2.7V, Vsd = 2.7V, Pin = -14dBm JESD22-A108	500 hours	0/77
Wet High Temperature Operating Life (WHTOL)	85°C/85%RH; Vdd = 2.7V, Vsd = 2.7V EIA/JESD22-A101	500 hours	0/60

Table 4. Environmental Tests Results:

Stress	Conditions	Duration	Failures / Number tested
Low Temperature Storage	-40°C, JESD22-A119	500 hours	0/80
Wet & High Temperature Storage	85°C/85%RH	500 hours	0/60
Thermal Cycle	-55/125°C, 15 minutes dwell, 10 minute transfer. JESD22-A104	500 cycles 1000 cycles [2]	0/81
Thermal Shock	-65°C /150°C, 5mins dwell, 10secs transfer JESD22-A106	500 cycles 1000 cycles [2]	0/81
Solderability (PbFree)	Steamage 1hour, 245°C, dip for 5sec JESD22-B102	1x	0/22

2. Conducted on ALM-GP002

Table 5. Mechanical Test Results

ALM-1612/ALM-GP002/ALM-GP003

Test	Test Condition	Test point	Results
Drop Test	1500Gs, pulse duration 1ms	30 drops	0/30
Cycle Bending Test	Amplitude ±1.0mm, Bending rate 80mm per min	5x	0/30
Shear Test	force 10N for 60 sec	4 sides	0/30
Bending Test	Bend up to 5 mm with 1mm increment. Maintained in bend state for 5 +/- 1s	Every 1mm	0/30

Table 6. Thermal Resistance Information:

Product	Test Condition	Theta Jc
ALM-1612	Vdd= 2.7V, Idd=6mA (typ)	133.3°C/W
ALM-GP002	Vdd= 2.8V, Idd=6mA (typ)	84.2°C/W
ALM-GP003	Vdd=2.7V, Idd=6mA (typ)	82.1°C/W

Table 7. Electrostatic Discharge (ESD) Ratings:

ALM-1612

ESD test	Reference	Results
Human Body Model (HBM)	EIA/JESD22-A114-1A	300V (Class1A)
Machine Model (MM)	EIA/JESD22-A115-A	70V (Class A)

ALM-GP002

ESD test	Reference	Results
Human Body Model (HBM)	EIA/JESD22-A114-1A	450V (Class1A)
Machine Model (MM)	EIA/JESD22-A115-A	50V (Class A)

ALM-GP003

ESD test	Reference	Results
Human Body Model (HBM)	EIA/JESD22-A114-B	250V (Class1A)
Machine Model (MM)	EIA/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.

Handling Precautions

Note: The device is classified as ESD sensitive. The following precautions should be taken:

1. Ensure Faraday cage or conductive shield bag is used when the device is transported from one destination to another.
2. At SMT assembly station, if the static charge is above the device sensitivity level, place an ionizer near to the device for charge neutralization purpose.
3. Personal grounding has to be worn at all time when handling the device.

Moisture Sensitivity Level: Level 3

Preconditioning (JESD22-A113) per level 3: was performed on all devices prior to reliability testing except for solderability and ESD classification.

MSL 3 Preconditioning (JESD22-A113): 125°C HTSL for 24hrs + 30°C/60%RH for 192hrs + 3x PbFree Reflow, 260°C max.

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