Reliability Qualification Report

SBA-5086Z - Matte Sn, RoHS compliant

Products Qualified by Similarity

SBA-4086Z

Initial Qualification	**12-2005**

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I. Qualification Overview

The SBA-5086Z has demonstrated reliable operation by passing all qualification testing in our product qualification test plan. The SBA-5086Z has been subjected to stresses such as humidity (HAST and autoclave), extreme hot and cold environments (temperature cycling), moisture sensitivity (MSL-1 and solder reflow testing), and High Temperature Operating Life (HTOL).

II. Introduction

Sirenza Microdevice's SBA-5086Z is a high performance InGaP/GaAs Heterojunction Bipolar Transistor MMIC Amplifier. A Darlington configuration designed with InGaP process technology provides broadband performance up to 5 GHz with excellent thermal performance. The heterojunction increases breakdown voltage and minimizes leakage current between junctions. Cancellation of emitter junction non-linearities results in higher suppression of intermodulation products. Only a single positive supply voltage, DC-blocking capacitors, a bias resistor, and an optional RF choke are required for operation.

III. Fabrication Technology

The SBA-5086Z amplifier is manufactured using a InGaP/GaAs Heterojunction Bipolar Transistor (HBT) technology. The devices are fabricated using MOCVD epitaxy technology which produces consistent and reproducible performance from lot to lot. Through the use of InGaP emitters, a mature MMIC fabrication process and rigorous in-process monitoring, excellent reliability with MTTF of greater than 1 x 10^6 hrs at 150°C have been achieved.

IV. Package Type

The SBA-5086Z power amplifier is packaged in a plastic encapsulated Micro-86 package that is assembled using a highly reproducible automated assembly process. The die is mounted using an industry standard thermally and electrically conductive silver epoxy. The ground leads are fused to the paddle to provide a low thermal resistance heat conduction path.

Figure 1 : Photograph of Exposed Pad 8 Encapsulated Plastic Package

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V. Qualification Methodology

The Sirenza Microdevices qualification process consists of a series of tests designed to stress various potential failure mechanisms. This testing is performed to ensure that Sirenza Microdevices products are robust against potential failure modes that could arise from the various die and package failure mechanisms stressed. The qualification testing is based on JESD test methods common to the semiconductor industry. The manufacturing test specifications are used as the PASS/FAIL criteria for initial and final DC/RF tests.

VI. Qualification By Similarity

A device can be qualified by similarity to previously qualified products provided that no new potential failure modes/mechanisms are possible in the new design. The following products have been qualified by similarity to SBA-5086Z:

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VII. Operational Life Testing

Sirenza Microdevices defines operational life testing as a DC biased elevated temperature test performed at the maximum operational junction temperature limit. For the SBA-5086Z the maximum operational temperature limit is 150^{o}C. The purpose of the operational life test is to statistically show that the product operated at its maximum operational ratings will be reliable by operating several devices for a total time of 1000 hours. The results for this test are expressed in device hours that are calculated by multiplying the total number of devices passing the test by the number of hours tested.

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VIII. Moisture Sensitivity Level - MSL Level 1 Device

Sirenza Microdevices classifies moisture sensitivity levels (MSL) according to the JESD 22-A113 convention. Moisture sensitivity levels are ranked from level 1 (most resistive to moisture) to level 5 (least resistive to moisture). The moisture sensitivity level is determined by a moisture soak test (temperature and humidity) for various temperatures, humidity levels, and times according to the requirements for a particular level, followed by three passes through a convection reflow oven at 270°C. This simulates stress from storage in high humidity environments and immediate assembly. For a device to be classified level 1 (MSL-1), the device must pass manufacturing test specifications following the moisture soak and reflow test. The results of the testing classify SBA-5086Z as MSL-1, the most resistant to humidity, indicating that no special anti-moisture packaging or handling is required.

IX. Electrostatic Discharge Classification

Sirenza Microdevices classifies Human Body Model (HBM) electrostatic discharge (ESD) according to the JESD22-A114 convention. All pin pair combinations were tested. Each pin pair is stressed at one static voltage level using 1 positive and 1 negative pulse polarity to determine the weakest pin pair combination. The weakest pin pair is tested with 3 devices below and above the failure voltage to classify the part. The Pass/Fail status of a part is determined by the manufacturing test specification. The ESD class quoted indicates that the device passed exposure to a certain voltage, but does not pass the next higher level. The following table indicates the JESD ESD sensitivity classification levels.

Class	Passes	Fails
0	0 V	<250 V
1A	250 V	500 V
1B	500 V	1000 V
1C	1000 V	2000 V
2	2000 V	4000 V

Part Number	HBM ESD Rating
SBA-5086Z	Class 1C

X. Operational Life Test Results

HTOL Completion Date	Test Duration	Junction Temperature	Quantity	Device-Hours
December 2005	**1000 hours**	**150°C**	**80**	**80,000**

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XI. Qualification Test Results				
Group	**Test Name**	**Test Condition/ Standard**	**Sample Size**	**Results**
B	Preconditioning	MSL1 Reflow @ 270ºC Peak JESD22-A113C	240	Pass[1]
B1a	Temperature Cycling	Air to Air, Soldered on PCB -65ºC to 150ºC 10 min dwell, 1 min transition 1000 cycles JESD22-A104B	24	Pass
B1b	High Temperature Operating Life	T_j = 150°C 1000 hours JESD22-A108B	80	Pass
B1c	HAST	T_{amb}=110°C, 85%RH Biased, 264 hours JESD22-A110B	15	Pass
B1d	Power Temperature Cycle	-40°C to +85°C Cycled bias (5' on/5'off) 1000 cycles JESD22-A109A	20	Pass

(1) 1 device failed for improper assembly.

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XI. Qualification Test Results

Group	Test Name	Test Condition/ Standard	Sample Size	Results
B2	Autoclave	T_{amb}=121°C, 100%RH Un-Biased, 96 hours JESD22-A102C	30	Pass
B3	Temperature Cycle	-65°C to +150°C 10 min dwell, 1 min transition 1000 cycles JESD22-A104B	30	Pass
C	Low Temperature Storage	T_{amb}=-65°C 1000 hours JESD22-A103B	30	Pass
D	High Temperature Storage	T_{amb}=150°C 1000 hours JESD22-A103B	30	Pass
F	Tin Whisker	T_{amb}=60°C, 90%RH 2600 hours NEMI	10	Pass
G	Solderability	Dip & Look Steam Age Condition C Dip Condition A, 215°C JESD22-B102C	15	Pass
		Dip & Look Steam Age Condition C Dip Condition B, 245°C JESD22-B102C	30	Pass

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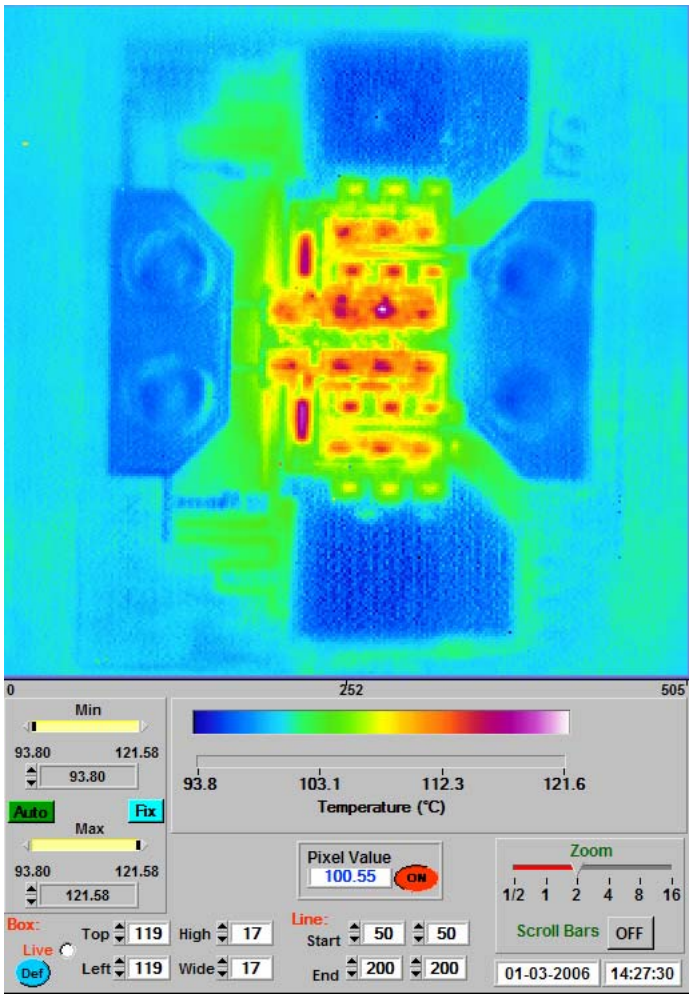
XII. Junction Temperature Determination

One key issue in performing qualification testing is to accurately determine the junction temperature of the device. Sirenza Microdevices uses a 3um spot size emissivity corrected infrared camera measurement to resolve the surface temperature of the device at the maximum operational power dissipation. The results are displayed below for the SBA-5086Z device running at operational current of 83 mA, a device voltage of 4.65 V, lead temperature of 85°C, and no RF applied.



Tj = 121.6°C

Figure 2: Infrared Thermal Image of SBA-5086Z, Vd = 4.65 V, Id = 83 mA, Tc = 85°C

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