# Reliability Report

## SGA/SGC Series in SOT-86 Package

### SnPb Plated

| | | | | |
|---|---|---|---|---|
| SGA-2186 | SGA-3286 | SGA-4186 | SGA-5286 | SGA-6286 |
| SGA-2286 | SGA-3386 | SGA-4286 | SGA-5386 | SGA-6386 |
| SGA-2386 | SGA-3486 | SGA-4386 | SGA-5486 | SGA-6486 |
| SGA-2486 | SGA-3586 | SGA-4486 | SGA-5586 | |
| | | SGA-4586 | | |

### Matte Sn, RoHS Compliant

| | | | | | |
|---|---|---|---|---|---|
| SGA-2186Z | SGA-3286Z | SGA-4186Z | SGA-5286Z | SGA-6286Z | SGC-2386Z |
| SGA-2286Z | SGA-3386Z | SGA-4286Z | SGA-5386Z | SGA-6386Z | SGC-2486Z |
| SGA-2386Z | SGA-3486Z | SGA-4386Z | SGA-5486Z | SGA-6486Z | SGC-4386Z |
| SGA-2486Z | SGA-3586Z | SGA-4486Z | SGA-5586Z | | SGC-4486Z |
| | | SGA-4586Z | | | SGC-6386Z |

*303 S. Technology Ct, Broomfield CO, 80021* *Phone: (800) SMI-MMIC* *http://www.sirenza.com*

*Document RQR-105584 Rev A*

# SGA/SGC in SOT-86 Reliability Report

## I. Overview

This reliability report describes the reliability test conditions and results for the SGA and SGC series of Transistors and Gain Blocks. The data is comprised of initial qualification tests and reliability monitoring tests. These tests include humidity (autoclave), extreme hot and cold environments (temperature cycling), moisture sensitivity (MSL-1 and solder reflow testing).

## II. Introduction

Sirenza Microdevices' SGA family are Silicon Germanium (SiGe) Gain Blocks that offer benefits not attainable with conventional silicon bipolar technologies. This family of products offer lower power consumption, high output power at high efficiency, high integration levels, at low cost.

Sirenza Microdevices SGC family of products are low cost, high performance SiGe HBT gain blocks. These Darlington designs contain a patented active bias network that provides stable current over temperature and process variations.

## III. Fabrication Technology

These amplifiers are manufactured using a Silicon Germanium Heterojunction Bipolar Transistor (HBT) technology. This self-aligned emitter, double poly HBT process has been in production by our foundry since 1998. The process has been successfully used for a wide range of RFIC products including GSM PAs, DECT front end transceivers, LNAs & VCOs. This process offers comparable performance to GaAs HBTs with the added advantages of mature and high producible Silicon wafer processing.

## IV. Package Type

These SGA/SGC products are packaged in a plastic encapsulated SOT-86 package that is assembled using a highly reproducible automated assembly process. The "Z' designates a lead-free lead frame using matte Tin plated leads and Green molding compound. The die is mounted using an industry standard thermally and electrically conductive silver epoxy.

SIRENZA MICRODEVICES

# SGA/SGC in SOT-86 Reliability Report

## 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 JEDEC test methods common to the semiconductor industry. A FMEA approach is used to determine the test methods to be included in the qualification plan. The manufacturing test specifications are used as the PASS/FAIL criteria for initial and final DC/RF tests.

## VI. Qualification Family

The SGA/SGC products use the same IC technology, process and materials, as well as the assembly process and materials. All parts numbers listed on the cover page are categorized as on qualification family and are qualified by association when one family member successfully completes qualification.

## 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 SGA/SGC family, the maximum operational temperature limit is 150°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 hundred 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.

## VIII. Moisture Sensitivity Level - MSL Level 1 Device

The SGA/SGC family of products have successfully completed 168 hours of moisture soak (85°C/85%RH), followed by three passes through a convection reflow oven at 270°C (Z versions), or at 235°C (non-Z versions). The successful completion of this test classifies the part as JESD 22-A113B Moisture Sensitivity Level 1 (MSL-1). MSL-1 indicates that no special dry pack requirements or time limits from opening of static bag to reflow exist for these products. MSL-1 is highest level of moisture resistance that a device can be classified according to the above mentioned standard.

SIRENZA MICRODEVICES

# SGA/SGC in SOT-86 Reliability Report

## 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 | ESD Rating |
|---|---|
| SGA-2186/2186Z | 1A |
| SGA-2386/2386Z | 0 |
| SGA-2486/2486Z | 0 |
| SGA-3x86/3x86Z | 0 |
| SGA-4186/4186Z | 1A |
| SGA-4286/4286Z | 1A |
| SGA-4486/4486Z | 1A |
| SGA-4586/4586Z | 1A |
| SGA-5286/5286Z | 1A |
| SGA-5486/5486Z | 1B |
| SGA-6486/6486Z | 1A |
| SGA-6586/6586Z | 1A |

## X. Operational Life Test Results

| Date | Test Duration | Junction Temperature | Quantity | Device Hours |
|---|---|---|---|---|
| **Q1-00** | **1000 hrs** | **125°C** | **398** | **398,000** |
| **Q3-00** | **1000 hrs** | **150°C** | **42** | **42,000** |
| **Q4-00** | **1000 hrs** | **150°C** | **60** | **60,000** |
| **Q2-02** | **1000 hrs** | **150°C** | **42** | **42,000** |
| **Q4-02** | **1000 hrs** | **150°C** | **42** | **42,000** |
| **Q3-03** | **1000 hrs** | **150°C** | **20** | **20,000** |
| **Q4-04** | **1000 hrs** | **150°C** | **40** | **40,000** |
| **Q4-04 (Z)** | **1000 hrs** | **150°C** | **80** | **80,000** |

SIRENZA MICRODEVICES

# SGA/SGC in SOT-86 Reliability Report

## XI. Qualification Test Results

| Group | Test Name | Test Condition/ Standard | Sample Size | Results |
|---|---|---|---|---|
| B | Preconditioning[1] | MSL1<br>Reflow @ 235°C Peak<br>JESD22-A113C<br>(Non-Z version) | 1480 | Pass |
| | | MSL1<br>Reflow @ 270°C Peak<br>JESD22-A113C<br>(Z version) | 305 | Pass |
| B1a | Temperature Cycling | Air to Air, Soldered on PCB<br>-65°C to 150°C<br>10 min dwell, 1 min transition<br>1000 cycles<br>JESD22-A104B<br>(Non-Z version) | 13 [2] | Pass |
| | | Air to Air, Soldered on PCB<br>-65°C to 150°C<br>10 min dwell, 1 min transition<br>1000 cycles<br>JESD22-A104B<br>(Z version) | 40 | Pass |
| B3 | Temperature Cycle | -65°C to +150°C<br>10 min dwell, 1 min transition<br>500 cycles<br>JESD22-A104B<br>(Non-Z version) | 371 | Pass |
| | | -65°C to +150°C<br>10 min dwell, 1 min transition<br>1000 cycles<br>JESD22-A104B<br>(Z version) | 30 | Pass |

(1) Preconditioning for Test Groups Bxx
(2) 1 unit removed for bond defect (FA04173)

SIRENZA MICRODEVICES

# SGA/SGC in SOT-86 Reliability Report

## XI. Qualification Test Results

| Group | Test Name | Test Condition/ Standard | Sample Size | Results |
|---|---|---|---|---|
| B1b | High Temperature Operating Life | Tj = 150°C[3]<br>1000 hours<br>JESD22-A108B<br>(Non-Z version) | 644 | Pass |
| | | Tj = 150°C<br>1000 hours<br>JESD22-A108B<br>(Z version) | 80 | Pass |
| B1c | HAST | Tamb=110°C, 85%RH<br>Biased, 264 hours<br>JESD22-A110B<br>(Non-Z version) | 10 | Pass |
| | | Tamb=110°C, 85%RH<br>Biased, 264 hours<br>JESD22-A110B<br>(Z version) | 25 | Pass |
| B2 | Autoclave | Tamb=121°C, 100%RH<br>Un-Biased, 96 hours<br>JESD22-A102C<br>(Non-Z version) | 269 | Pass |
| | | Tamb=121°C, 100%RH<br>Un-Biased, 96 hours<br>JESD22-A102C<br>(Z version) | 30 | Pass |

(3) 398 units were done at Tj=125C

# SGA/SGC in SOT-86 Reliability Report

## XI. Qualification Test Results

| Group | Test Name | Test Condition/ Standard | Sample Size | Results |
|---|---|---|---|---|
| B1d | Power Temperature Cycle | -40°C to +85°C<br>Cycled bias (5' on/5'off)<br>1000 cycles<br>JESD22-A109A<br>(Non Z version) | 10 | Pass |
| | | -40°C to +85°C<br>Cycled bias (5' on/5'off)<br>1000 cycles<br>JESD22-A109A<br>(Z version) | 30 | Pass |
| C | Low Temperature Storage | Tamb=-40°C<br>1000 hours<br>(Non Z version) | 20 | Pass |
| | | Tamb=-40°C<br>1000 hours<br>(Z version) | 40 | Pass |
| D | High Temperature Storage | Tamb=150°C<br>1000 hours<br>JESD22-A103B<br>(Non Z version) | 218 | Pass |
| | | Tamb=150°C<br>1000 hours<br>JESD22-A103B<br>(Z version) | 40 | Pass |

SIRENZA MICRODEVICES

# SGA/SGC in SOT-86 Reliability Report

## XI. Qualification Test Results

| Group | Test Name | Test Condition/ Standard | Sample Size | Results |
|---|---|---|---|---|
| F | Tin Whisker | Tamb=60°C, 90%RH<br>2600 hours | 10 | Pass |
| K | Solderability | Dip & Look<br>Steam Age Condition C<br>Dip Condition A, 215°C<br>JESD22-B102C<br>(Non-Z version) | 59 | Pass |
| | | Dip & Look<br>Steam Age Condition C<br>Dip Condition A, 215°C<br>JESD22-B102C<br>(Z version) | 15 | Pass |
| | | Dip & Look<br>Steam Age Condition C<br>Dip Condition B, 245°C<br>JESD22-B102C<br>(Z version) | 15 | Pass |

SIRENZA MICRODEVICES

# SGA/SGC in SOT-86 Reliability Report

## 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. Results are displayed below for the SGA-6486 and SGA-6586Z.

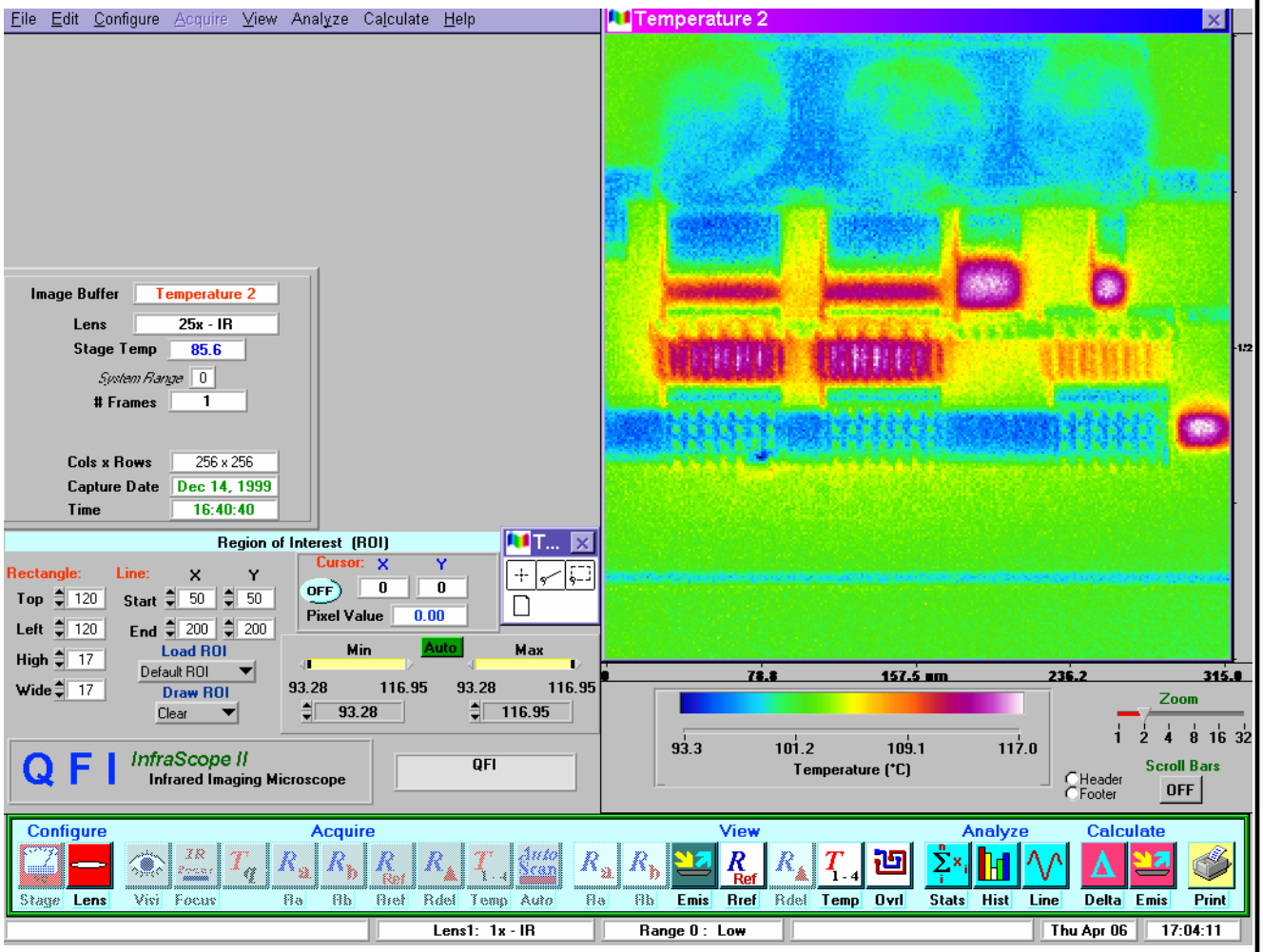


Figure 1: Infrared Thermal Image of SGA-6486, Vd = 4.65V, Id = 80.3mA, Tlead = 85.5°C

SIRENZA MICRODEVICES

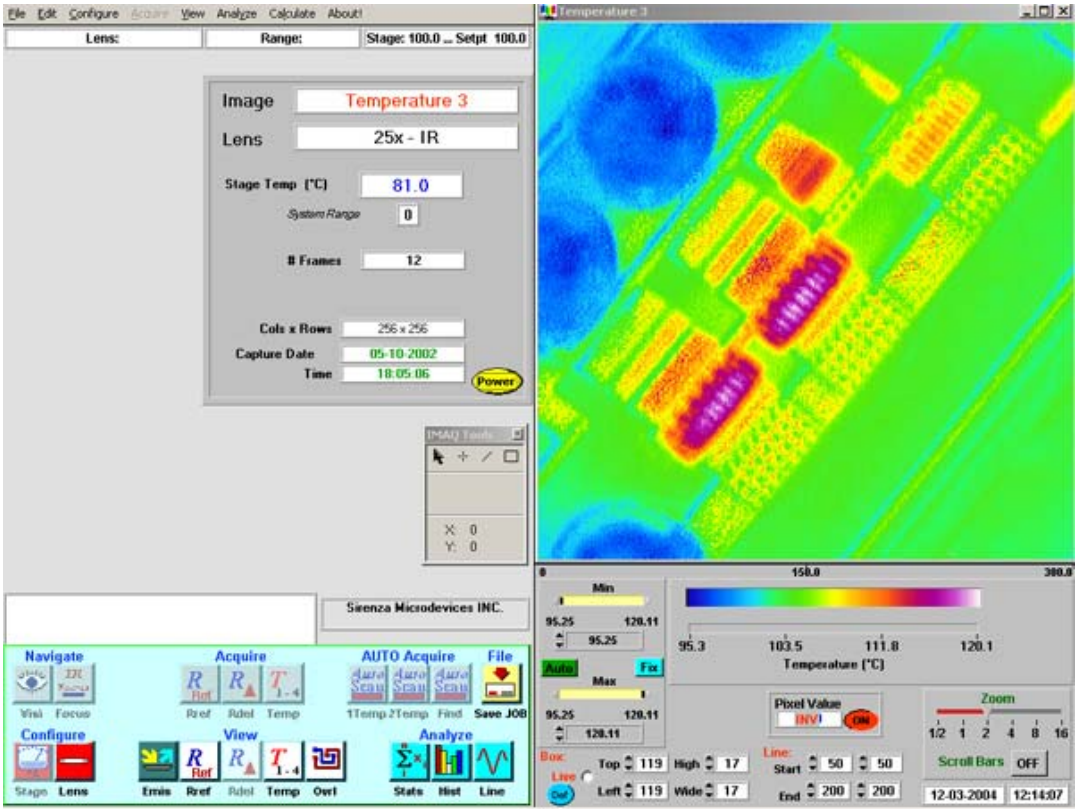


Figure 2: Infrared Thermal Image of SGA-6586Z, Vd = 4.50V, Id = 80.2mA, Tlead = 84.5°C