HVV1011-035/SMD

New Product and New Package

Date: November 28, 2009

HVV1011-035 Reliability Qualification Report

Table of Contents

Executive Summary………………………………………………………….. 2

Background Information……………………………………………….. 2

Qualification Tests and Results………………………………………… 3

Explanation of Tests……………………………………………………. 4

Qualification by Similarity……………………………………………... 5

Summary………………………………………………………………... 5

Purpose

This report qualifies the HVV1011-035 device in the Surface Mount Device (SMD) package. The die is fabricated at ON Semiconductor's COM1 facility in Phoenix, Arizona. The package is assembled at the HVVi® assembly site in Phoenix, Arizona.

Background Information

The HVV1011-035 device is a high voltage silicon enhancement mode RF transistor designed for L-Band pulsed avionics applications operating in the frequency range of 1030MHz to 1090MHz. It is rated at 35 Watts. The device features high power gain, excellent ruggedness, and a 48V supply voltage. Table 1 provides a description of the device.

The qualification consisted of three wafer lots which were fabricated at ON Semiconductor's COM1 facility in Phoenix, Arizona. Multiple assembly lots were manufactured at HVVi in Phoenix, Arizona. The reliability stress tests were performed per industry standards (JEDEC, AEC, and MIL-STD-883). Reliability stress tests were performed at two different locations. The reliability facilities used were ON Semiconductor's Reliability Lab and Silicon Cert, Ltd as detailed in Table 2.

Table 1. General device description of the HVV1011-035.

Device	HVV1011-035		**Wafer Fab Site**	ON Semiconductor, COM1	Phoenix, Arizona
Package	SMD		**Assembly Site**	HVVi	Phoenix, Arizona
Technology	HVVFET™		**Final Test Site**	HVVi	Phoenix, Arizona

HVVi semiconductors™

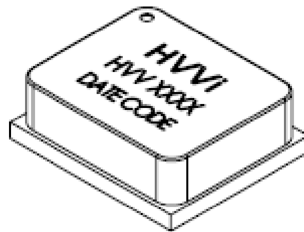


Figure 1. Package drawing of the HVV1011-035.

Table 2. List of reliability lab companies, locations, and tests performed.

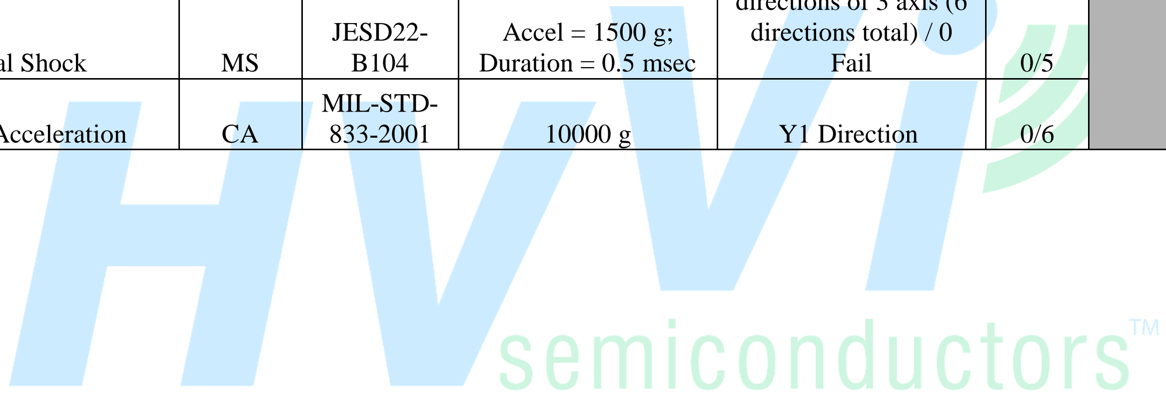
Reliability Lab	**Location**	**Tests Completed**
ON Semiconductor Reliability Lab	Phoenix, Arizona	Temperature Cycling
Silicon Cert, Ltd.	Pennsylvania	Mechanical Shock, Variable Vibration Frequency, Constant Acceleration, Solderability

Qualification Tests and Results

The qualification tests were performed per standard test conditions (JEDEC, AEC-101, MIL-STD-883). Sample sizes were chosen per recommended sizes or per Lot Tolerance Percent Defective (LTPD) Sampling based on the Military Standards (5% level).

Table 3. A list of reliability tests completed for the HVV1011-300 qualification.

Stress	Abbv.	Ref.	Conditions	Duration/ Acceptance	Lot A	Lot B	Lot C
Electrical Parameter Assessment	ED	JESD86	Datasheet	Per datasheet	All	All	All
Temperature Cycling	TC	JESD22-A104	-40 °C to +125 °C	1000 cycles / 0 Fail	0/45	0/45	0/45
Thermal Resistance Measurements (Average & Pulsed)	θ_{JC}	JESD24-3	Under spec operating conditions	Characterize device	0/5	0/5	0/5
Solderability	SD	JESD22-B102E	Per std	0 Fail	0/15		
Variable Vibration Frequency	VVF	JESD22-B103	20 – 2000 Hz, Peak force = 20 g	4 min with 4 travels per axis / 0 fail	0/5		
Mechanical Shock	MS	JESD22-B104	Accel = 1500 g; Duration = 0.5 msec	5 times in both directions of 3 axis (6 directions total) / 0 Fail	0/5		
Constant Acceleration	CA	MIL-STD-833-2001	10000 g	Y1 Direction	0/6		



Explanation of Tests

Stress Test/Specification: Temperature Cycling (TC)/JESD22-A104
Conditions: Ta = -40 °C to +125 °C; unbiased
Read Points: 0, 100, 500, and 1000 cycles
Sample Size: 3 lots, 45 units each (per LTPD 5% level with no failures)
Purpose: Accelerate failure mechanisms caused by cycling between high and low temperatures.
Possible Failure Mechanisms/Modes: Failure mechanisms include fatigue and cracking related failures such as broken bonds or cracked die due to stresses caused by thermal mismatches in Coefficients of Thermal Expansion (CTE). Failure modes include degradation of thermal and electrical characteristics and catastrophic failure. Thermal and electrical parameters affected include Rdson, R(θ)jC, Vdss, and Vgs.

Stress Test/Specification: Solderability (SD)/JESD22-B102E
Conditions: Per standard.
Sample Size: 1 lot, 15 units
Purpose: Evaluate the ability of the component leads and/or package terminations to be wetted and produce an adequate fillet when coated with solder.
Possible Failure Mechanisms: Failure mechanisms include contamination on the package terminations/leads or other plating anomalies. Failure modes include solder voids, pinholes, and inadequate wetting of the leads and/or package terminations.

Stress Test/Specification: Vibration, Variable Frequency/JESD22-B103
Conditions: 20 – 2000 Hz, Peak force = 20 g
Sample Size: 1 lot, 5 units
Purpose: Evaluate a device when subjected to vibration in a specified frequency range.
Possible Failure Mechanisms: Failure mechanisms include fatigue, fracture, wear, corrosion fatigue, and stress corrosion cracking. Failure modes include degradation of operating characteristics, catastrophic failure, or mechanical damage similar to that resulting from excessive vibration.

Stress Test/Specification: Mechanical Shock (MS)/JESD22-B104
Conditions: Acceleration = 1500 g, Duration = 0.5 msec
Sample Size: 1 lot, 5 units
Purpose: Evaluate a device subjected to moderately severe shocks as a result of sudden applied forces or abrupt changes in motion which simulate heavy usage, transportation, or field applications.
Possible Failure Mechanisms/Modes: Failure mechanisms include fatigue, fracture, wear, corrosion fatigue, and stress corrosion cracking. Failure modes include degradation of operating characteristics, catastrophic failure, or mechanical damage similar to excessive vibration, particularly if the shock pulses are repetitive.

HVVi semiconductors™

Stress Test/Specification: Constant Acceleration (CA)/MIL-STD-883 Method 2001
Conditions: 10000 g, six axial directions
Sample Size: 1 lot, 6 units
Purpose: Evaluate structural and mechanical weaknesses not necessarily detected in shock and vibration testing. Mechanical limitations of the package can be assessed including the internal metallization and lead system, the die or substrate attachment, and other structures of the device.
Possible Failure Mechanisms/Modes: Failure mechanisms include fatigue, fracture, wear, corrosion fatigue, and stress corrosion cracking. Failure modes include degradation of operating characteristics, catastrophic failure, or mechanical damage similar to that resulting from excessive vibration, particularly if the shock pulses are repetitive.

Qualification by Similarity

The following device is qualified by similarity to the HVV1011-035 based on similarity in wafer technology, fabrication, die size, assembly manufacturing, and materials:

HVV1214-025

HVVi semiconductors™

Summary

The reliability test results documented herein qualify the HVV1011-035 device and the SMD package. The die is supplied by ON Semiconductor's COM1 facility in Phoenix, Arizona and the package is assembled at HVVi in Phoenix, Arizona. The HVV1011-035 device meets or exceeds HVVi's requirements for product reliability.