MSOP
Package Reliability Qualification Report

Abstract

This report summarizes package qualification test results obtained on an 8 pin MSOP package. The MSOP plastic package is manufactured by supplier H. The TQ9121 was used as the qualification test vehicle. A TQ9121 is a Low Noise Amplifier that operates with a single power supply. Tests, test sample sizes and failure criteria were defined by TriQuint's Specification REL.021 (*Policy and Procedure for Reliability Qualifications of ICs*). Most tests outlined in this procedure follow the JEDEC Standard Number 26-A or MIL-STD-883 when applicable. The requirement of measuring devices within 48 hours of stressing was an exception to the standard. Tests performed were Physical Dimensions, Marking Permanency, Solderability, Autoclave, Unbiased Lifetest, Biased Humidity Lifetesting, HAST, Lead Integrity, Thermal Shock and Temperature Cycle.

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Introduction:

Various tests were performed on the MSOP plastic package. The tests that were performed are designed to evaluate the reliability of the plastic package. Table 1 shows the Test Plan used to qualify the MSOP plastic package. The TQ9121 die was used as the test vehicle. The standard TQ9121 is manufactured in a SOIC8 plastic package, therefore all the test programs had been written for this device. To test the MSOP package a new test board was designed.

Table 1. Package Qualification Test Plan.

Item #	Test Name	Purpose	Specification/Method	Sample Size
1	Physical Dimensions	Determine if the final assembly meets the package drawing.	JEDEC STD 22, Method B100	2
2	Mark Permanency	Determine if package marking is suitable for normal use.	JEDEC STD 22, Method B107	4
3	Solderability	Determine if the package leads are suitable for soldering.	JEDEC STD 22, Method B102 Condition C	4
4	Autoclave	Determine if package can withstand a humid environment.	JEDEC STD 22, Method A102	80
5	Lifetest	Determine Long Term Functionality.	Unbiased Ambient Temperature: 150^{o}C	81
6	Biased Humidity Lifetest	Evaluate the reliability of non-hermetic package.	JEDEC STD 22, Method A101 Biased at +2 Volts	76
7	HAST	Evaluate the reliability of non-hermetic package.	JEDEC STD 22, Method A110 Biased at +2 Volts	80
8	Lead Integrity	Determine the package lead strength.	JEDEC STD 22, Method B105 Condition A 32 leads tested	4
9	Thermal Shock	Material Thermal Mismatch.	JEDEC STD 22, Method A106 -40^{o}C to +125^{o}C 100 cycles	80
10	Temperature Cycling	Material Thermal Mismatch.	JEDEC STD 22, Method A104 -40^{o}C to +125^{o}C, 1000 cycles	79

Package Description:

The TQ9121 is a Low Noise Amplifier (LNA) designed at TriQuint as a standard product in an SOIC8 plastic package. This device normally is used in a downconverter application from 1200 to 1600 MHz. The amplifier requires a single positive supply at a range from 4.4 to 5.5 Volts DC. This circuit is fabricated with the QED/A process on a 80 mils X 53 mils square die that is 7 mils thick. For the qualification of the MSOP plastic package, the TQ9121 die was die-attached with conductive epoxy to an MSOP lead frame. The assembly process was performed by supplier H. During assembly, 1.25 mil gold bond wires are used to bond the circuit to the package lead frame. Since the MSOP plastic package is a small outline package, no die coating was used during the molding process.

Test Descriptions and Test Results:

Physical Dimensions:

Procedure: JEDEC STD-22-B, Method B100. Measure all critical mechanical dimensions.

Purpose: To determine whether the external physical dimensions of the device meet the specifications.

Failure: A dimension or dimensions not in conformance with the specified tolerance.

Results:

Date	Sample Size	Failures
Jan. 96	2	0

Mark Permanency:

Procedure: JEDEC STD-22-B, Method B107. Subject packages to 4 different solvents and brushing on the package markings.

Purpose: To verify that the markings on the devices will not become illegible when subjected to solvents or cleaning solutions commonly used for removing solder flux residue after a soldering process.

Failure: If marking is illegible.

Results:

Date	Sample Size	Failures
Jan. 96	4	0

Solderability:

Procedure: JEDEC STD-22-B, Method B102. Steam age devices for a length of time (Condition C, 8 hours) then dip package leads into a solder pot (Condition B, 245°C for 5 Seconds).

Purpose: To verify the solderability of the device package leads.

Failure: The inspected area of each lead must be smooth and bright with 95% solder coverage minimum.

Results:

Date	Sample Size	Failures
Jan. 96	4	0

Autoclave:

Procedure: JEDEC STD-22-B, Method A102. Unbiased test at 2 Atm Saturated Steam, +121°C for 96 hours.

Purpose: To evaluate the moisture resistance of non-hermetically packaged integrated circuits.

Failure: A shift in output power from initial value of greater than 2 dBm/or visual defects on the case or the leads.

Results:

Date	Sample Size	Failures
Mar. 96	80	0

Lifetest

Procedure: Unbiased test at 150°C ambient temperature. Test points at 250, 500 and 1000 hours.

The lifetest board that was designed for this device caused the devices to oscillate. It was decided to run an unbiased lifetest at 150°C ambient temperature. The 150°C ambient temperature was selected because TriQuint specifies that the maximum operating temperature is 150°C junction temperature.

Purpose: To determine the long term affects of temperature.

Failure: A shift in output power from initial values of greater than 2 dBm.

Results:

Date	Sample Size	Failures
May. 96	81	0

Biased Humidity Lifetest:

Procedure: JEDEC STD-22, Method A101. A biased test at 85°C and 85% Relative Humidity. Test Points at 250, 500 and 1000 hours. The devices were biased at + 2 Volts.

The LNA was initially biased at 5 Volts, but at 5 Volts the devices oscillation. De-tuning was performed on the board, but the oscillations continued. The bias was lowered to reduce the gain of the amplifier. At 2 Volts no oscillations were noted.

Purpose: To determine the reliability of a plastic package in a humid environment.

Failure: A shift in output power from initial reads of greater than 2 dBm/or visual defects on the case or the leads.

Results:

Date	Sample Size	Failures
June 96	76	0

HAST:

Procedure: JEDEC STD-22, Method A110. A biased test at 130°C at 85% Relative Humidity, 96 hours. The devices were biased at + 2 Volts.

The Vdd for this test was set at 2 Volts to prevent the part from oscillating and to ensure that the part was biased in a low power state.

Purpose: To determine the reliability of a plastic package in a humid environment.

Failure: A shift in output power from initial reads of greater than 2 dBm/or visual defects on the case or the leads.

Results:

Date	Sample Size	Failures
Mar. 96	80	2

Failure analysis was performed on the two failures. ESD damage was noted. The ESD damage most likely occurred during the handling of the device during the test.

Lead Integrity:

Procedure: JEDEC STD-22-B, Method B105. Test Condition A - Tension; Test Condition B - Bending Stress; Test Condition C - Lead Fatigue.

Purpose: To determine the integrity of device leads, welds and seals.

Failure: Any lead breakage, lead fracture or package fracture is considered a failure.

Results:

Date	Sample Size	Failures
Jan. 96	32 leads tested	0

Thermal Shock (Liquid to Liquid)

Procedure: JEDEC STD-22-B, Method A-106. 100 cycles from -40^{o}C to +125^{o}C with a 5 minute dwell time at each extreme.

Purpose: To check the mechanical integrity of the packaged device, including the die attach, wire bonds, and leads.

Failure: A shift in output power from initial reads of greater than 2 dBm/or visual defects on the case or the leads.

Results:

Date	Sample Size	Failures
Mar. 96	80	0

Temperature Cycling (Air to Air)

Procedure: JEDEC STD 22 Method A104. 1000 Cycles from -40^{o}C to 125^{o}C

Purpose: To check the mechanical integrity of the packaged device including the die-attach, wire bonds and leadframe.

Failure: A shift in output power from initial values of greater than 2 dBm/or visual defects on the case or the leads.

Results:

Date	Sample Size	Failures
May 95	79	0

Summary

The MSOP plastic package was subjected to the various tests to determine if it was a reliable package. A TQ9121 LNA Amplifier was used as the test vehicle for testing the MSOP package.

Devices were tested on hand socket fixtures at all test points. Initial data was logged and reviewed. Since the TQ9121 was not designed for this package, some of the normal parameters did not meet the data book specification. It was decided to define the failure criteria as a 2 dB change in gain.

No failures occurred during the testing of the MSOP plastic package except during the HAST testing. At the end of 96 hours of HAST, two devices failed. Failure analysis was performed and ESD damage was found on both devices. It is suspected that the devices were damaged during handling.

In normal application, the TQ9121 is biased at 5 Volts. During the setup of biased tests, it was found that the amplifier would oscillate on the burn-in board. The cause of the oscillation was due to the long lead length of the socket pins. It was found that by adjusting the VDD voltage down to 2 Volts the oscillations would stop. The Biased Humidity and HAST tests were operated at 2 Volts. The lifetest was an unbiased test that was operated at 150^{o}C to try to simulate the maximum junction temperature.

The results of these tests indicates that the MSOP plastic package does not have any abnormalities and can be used for other Wireless Communications Division products.