ON Semiconductor

FINAL PRODUCT/PROCESS CHANGE NOTIFICATION #20346

Generic Copy

Issue Date: 09-Sep-2014

TITLE: Installation of back grind production line in OSPI Carmona for products that get wafer probe and assembly operations in OSPI

PROPOSED FIRST SHIP DATE: 15-Dec-2014 or earlier upon customer approval

AFFECTED CHANGE CATEGORY(S): Backgrind

FOR ANY QUESTIONS CONCERNING THIS NOTIFICATION:
Contact your local ON Semiconductor Sales Office or <thess.sangeles@onsemi.com>

SAMPLES: Contact your local ON Semiconductor Sales Office

ADDITIONAL RELIABILITY DATA: Available
Contact your local ON Semiconductor Sales Office or <thess.sangeles@onsemi.com>

NOTIFICATION TYPE:

Final Product/Process Change Notification (FPCN)

Final change notification sent to customers. FPCNs are issued at least 90 days prior to implementation of the change.

ON Semiconductor will consider this change approved unless specific conditions of acceptance are provided in writing within 30 days of receipt of this notice. To do so, contact <quality@onsemi.com>.

DESCRIPTION AND PURPOSE:

Products that currently get wafer probing and assembly in OSPI Carmona are shipped to a subcontractor for back grinding in between probing and assembly.

By installing the back grind capacity in OSPI we will reduce the cycle time, create extra capacity for back grinding and improve the quality by eliminating the non-added value shipping steps.

ON Semiconductor

FINAL PRODUCT/PROCESS CHANGE NOTIFICATION #20346

RELIABILITY DATA SUMMARY: See attached Files

To access file attachments on pdf copy of PCN, please be guided by the steps below:

1. *Download pdf copy of the PCN to your computer*
2. *Open the downloaded pdf copy of the PCN*
3. *Click on the paper clip icon available on the menu provided in the left/bottom portion of the screen to reveal the Attachment field*
4. *Then click on the attached file/s*

ELECTRICAL CHARACTERISTIC SUMMARY: Available upon request

LIST AFFECTED STANDARD DEVICES

0C624-006-XTD	FS6128-04G-XTD	NCV7340D12R2G
0C624-006-XTP	FS6128-04G-XTP	NCV7340D13G
20800-005-XTD	FS7140-01G-XTD	NCV7340D13R2G
AMIS30600LINI1G	FS7140-01G-XTP	NCV7340D14G
AMIS30600LINI1RG	FS7140-02G-XTD	NCV7340D14R2G
AMIS30621C6213G	FS7140-02G-XTP	NCV7342D10R2G
AMIS30621C6217G	NCN5150DG	NCV7383DB0R2G
AMIS30621C6217RG	NCN5150DR2G	NCV7420D23G
AMIS30622C6223G	NCS36000DG	NCV7420D23R2G
AMIS30622C6223RG	NCS36000DRG	NCV7420D24G
AMIS30623C6238G	NCS37000DBG	NCV7420D24R2G
AMIS30623C6238RG	NCS37000DBRG	NCV7420D25G
AMIS30660CANH2G	NCS37010DBG	NCV7420D25R2G
AMIS30660CANH2RG	NCS37010DBRG	NCV7420D26G
AMIS41682CANM1G	NCS37012DBG	NCV7420D26R2G
AMIS41682CANM1RG	NCS37012DBRG	NCV7424DB0R2G
AMIS41683CANN1G	NCV70501DW002G	NCV7425DW0G
AMIS41683CANN1RG	NCV70501DW002R2G	NCV7425DW0R2G
AMIS42665TJAA1G	NCV70522DQ004G	NCV7425DW5G
AMIS42665TJAA1RG	NCV70522DQ004R2G	NCV7425DW5R2G
AMIS42665TJAA6G	NCV70624DW010G	NCV7430D20R2G
AMIS42665TJAA6RG	NCV70624DW010R2G	NCV7462DQ0G
AMIS42670ICAH2RG	NCV70627DQ001G	NCV7462DQ0R2G
AMIS42671ICAB1G	NCV70627DQ001R2G	NCV7471DQ5G
AMIS42671ICAB1RG	NCV7321D10G	NCV7471DQ5R2G
AMIS42673ICAG1G	NCV7321D10R2G	NCV78663DQ0G
AMIS42673ICAG1RG	NCV7321D11G	NCV78663DQ0R2G
AMIS42770ICAW1G	NCV7321D11R2G	SCY4001DG
AMIS42770ICAW1RG	NCV7340D12G	SCY4001DR2G

	**RELIABILITY QUALIFICATION**

ON Semiconductor Back Grind/Die Sales Qualification

ON Semiconductor Philippines

Package Code : **SOIC**
Assembly Location : **ON Semiconductor Philippines**

Report ID : **0CANM_DP_A01**

Qual Version : **A01**

Date Released : **July 7, 2014**

Authored by : **ANDY F. ESTEVA**
Reliability Engineer

Approved by : **JOSEPHINE GUEVARRA**
OSPI and SBN Reliability Engineering Manager

Approved by : **DANIEL VANDERSTRAETEN**
Assembly Reliability Manager

RELIABILITY QUALIFICATION

Table of Contents

1.0 EXECUTIVE SUMMARY

As part of ON Semiconductor (OSPI) Back Grind/Die Sales line release a qualification was done using an SOIC package as test vehicle and was subject of various reliability tests. The reliability qualification was completed and all tests were concluded with passing results. The qualification was run according to ON Semiconductor Specification 12MON81348F, ON Semiconductor Assembly Reliability Qualification.

This qualification was initiated to qualify the newly acquired equipment installed in-house to support back grind/die sales operations and its associated processes. However, tape and reel process and machine for die sales was not covered, thus, defects induced by die sales' tape and reel process were not covered by the reliability qualification.

ON Semiconductor releases the package and materials set under consideration for dry pack level 2 of IPC/JEDEC standard J-STD-020 (Moisture/Reflow Sensitivity Classification for Non-Hermetic Solid State Surface Mount Devices). Solder temperature used during the qualification was 260°C.

2.0 OBJECTIVE

This project aims to qualify the new back grind and die sales lines installed at OSPI.

The reliability qualification was intended to simulate the processes of back grind and die sales in OSPI. A representative part from SOIC package with optional die sales requirement was selected to represent automotive products. Solder reflow temperature used during qualification was 260°C peak temperature.

Wafers for evaluation were thinned, sawn and assembled in OSPI, while wafers for control lot were shipped in wafer boat for wafer thinning to ATP1.

3.0 VERSION HISTORY

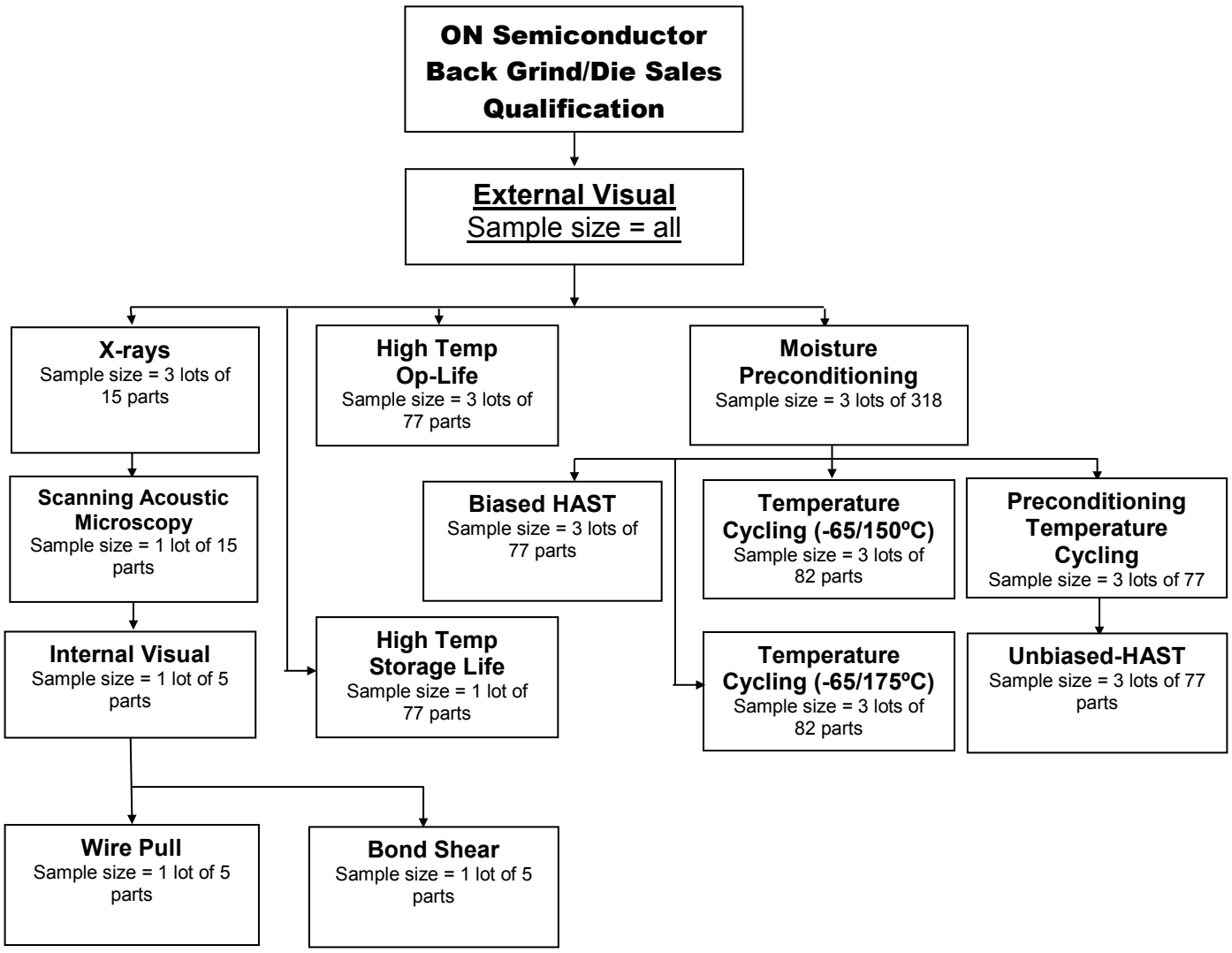
Version	Date	List of Modification
A01	07-July-2014	- OSPI back grind and die sales insourcing qualification_SOIC

4.0 TEST VEHICLE IDENTIFICATION

	QUAL LOTS	CONTROL LOT
Device Identification	: 0CANM-001	0CANM-001
Lot Identification	: D15031.1, D15032.1, D15033.1	D15034.1
Lot Assembly Datecode	: PAA1412, PPAB1412, PPAC1412	PPAA1412
Die-attach Material	: SUMITOMO CRM 1084P	SUMITOMO CRM 1084P
Mold compound	: EME G600	EME-G600
Die Coat Material	: N/A	N/A
Leadframe Material	: Copper	Copper
Lead Finish	: Matte Tin	Matte Tin
Lot Assembly House	: ON Semiconductor Phils.	ON Semiconductor Phils.
Lot Backgrind House	: ON Semiconductor Phils.	Amkor Technology Phils
Lot Wafer Saw House	: ON Semiconductor Phils.	ON Semiconductor Phils.
Package pin count	: 14 SOIC	14 SOIC
Body Size	: 150 mils	150 mils
Pad size	: 2.54 x 3.81 mm	2.54 x 3.81 mm
Die Size	: 3.25 x 1.85 mm	3.25 x 1.85 mm

5.0 QUALIFICATION REQUIREMENTS

QUALIFICATION FLOW



RELIABILITY QUALIFICATION

TEST CONDITIONS AND EQUIPMENT LIST

TEST	CONDITIONS	CHECKPOINTS	INSTRUMENT/ EQUIPMENT
Moisture Preconditioning • Bake • Humidity Soak • Reflow	 125°C 85°C / 60% RH 260°C	 24 hrs 168 hrs 3 cycles	 Blue M OV-500C-2 Blue M CFR-7752B Heller 1809EXL
Scanning Acoustic Microscopy	Not Applicable	Pre and Post MSL, Post TC	SONOSCAN CSAM Series D91000
Temperature Cycling	-65°C / 150°C; -65°C / 175°C	500, 1000 cycles	Thermotron
High Temperature Bake	150°C	500 hrs, 1000 hrs	Blue M OV-500C-2
High Temperature Op-life	125°C	500 hrs, 1000 hrs	AMT 14000
Biased HAST	130°C / 85°C RH	96 hrs	HIRIYAMA PC-422R8
Unbiased HAST	130°C / 85°C RH	96 hrs	HIRIYAMA PC-422R8
Bond Pull Test	Not Applicable	Not Applicable	Intellitest FA1800
Bond Shear Test	Not Applicable	Not Applicable	Intellitest FA1800
Electrical Testing	SW3, -40, 140°C	Not Applicable	Tester: TMT
External Visual	Not Applicable	Not Applicable	Nikon AFX-II
X-ray Inspection	Not Applicable	Not Applicable	YTX-300

6.0 DATA AND RESULTS

6.1.1 MOISTURE RESISTANCE TEST

PURPOSE:

The moisture sensitivity test evaluates the sensitivity of surface mount packages to humidity uptake during storage on the shelf before soldering on PCB board at customer's site. The failure mode found is known as the popcorn effect. Moisture sensitivity level 2 conditions with 260°C peak temperatures during solder reflow simulation were observed in the conduct of the test. The solder technique used was IR/Convection reflow.

REFERENCE STANDARD:

The test was run according to IPC/JEDEC standard J-STD-020D (Moisture/Reflow Sensitivity Classification for Non Hermetic Solid State Surface Mount Devices).

RESULT:

No functional failures were incurred after Moisture Resistance Test. Though, some parts showed sign of delamination on non-critical area of the lead finger upon acoustic

microscopy, after the parts were subjected to moisture preconditioning. Hence, there is no functional failure; the package passed Moisture Resistance Test.

TEST SEQUENCE	CONTROL LOT (Rej/SS)	QUAL LOT A (Rej/SS)	QUAL LOT B (Rej/SS)	QUAL LOT C (Rej/SS)
ACOUSTIC MICROSCOPY INSPECTION	0/318	0/318	0/318	0/318
BAKE DRY, 24 HOURS AT 125^{O}C	0/318	0/318	0/318	0/318
MOISTURE ABSORPTION, 85^{O}C/60% RH FOR 168 HOURS	0/318	0/318	0/318	0/318
REFLOW SOLDERING, 3X AT 260^{O}C	0/318	0/318	0/318	0/318
FUNCTIONAL TEST AT 140^{O}C	0/318	0/318	0/318	0/318
ACOUSTIC MICROSCOPY INSPECTION	0/75[1]	0/75[1]	0/75[1]	0/75[1]

[1] Evidence of delamination was observed on non-critical area of the lead finger.

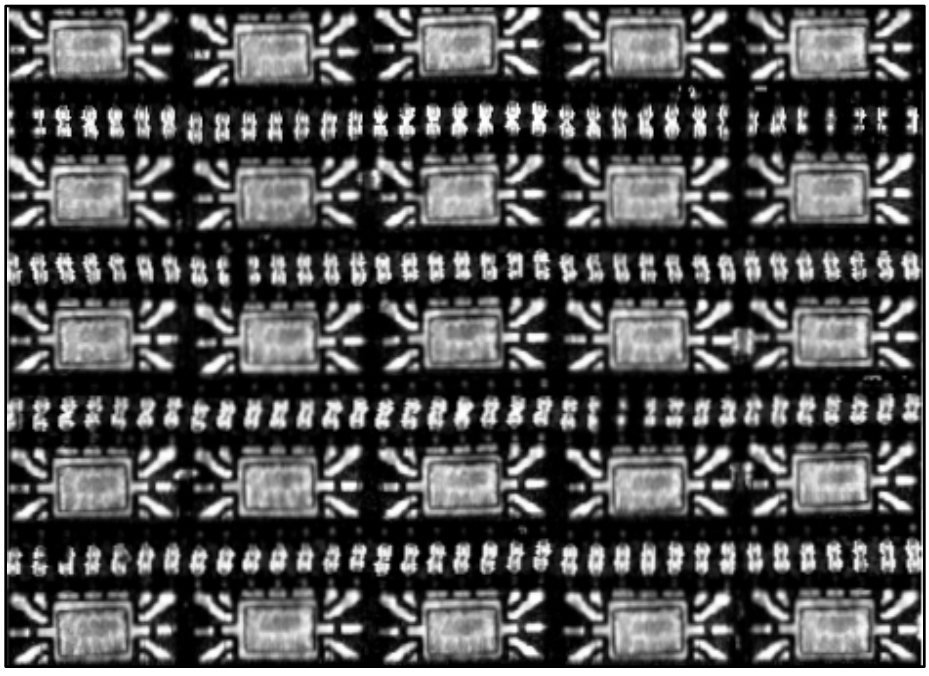


Figure 1: Acoustic Microscopy Image prior Moisture Resistance test. No package anomaly was observed.

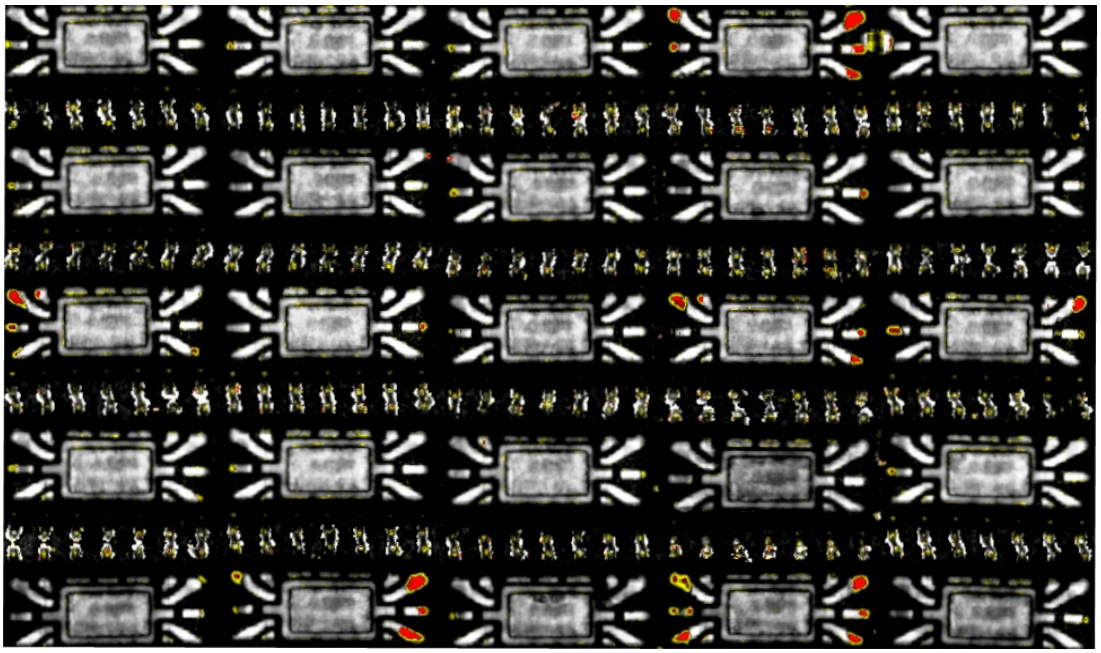


Figure 2: Acoustic Microscopy Image of **qualification lot** after Moisture Resistance test. Evidence of delamination was observed on non-critical area of the lead finger.

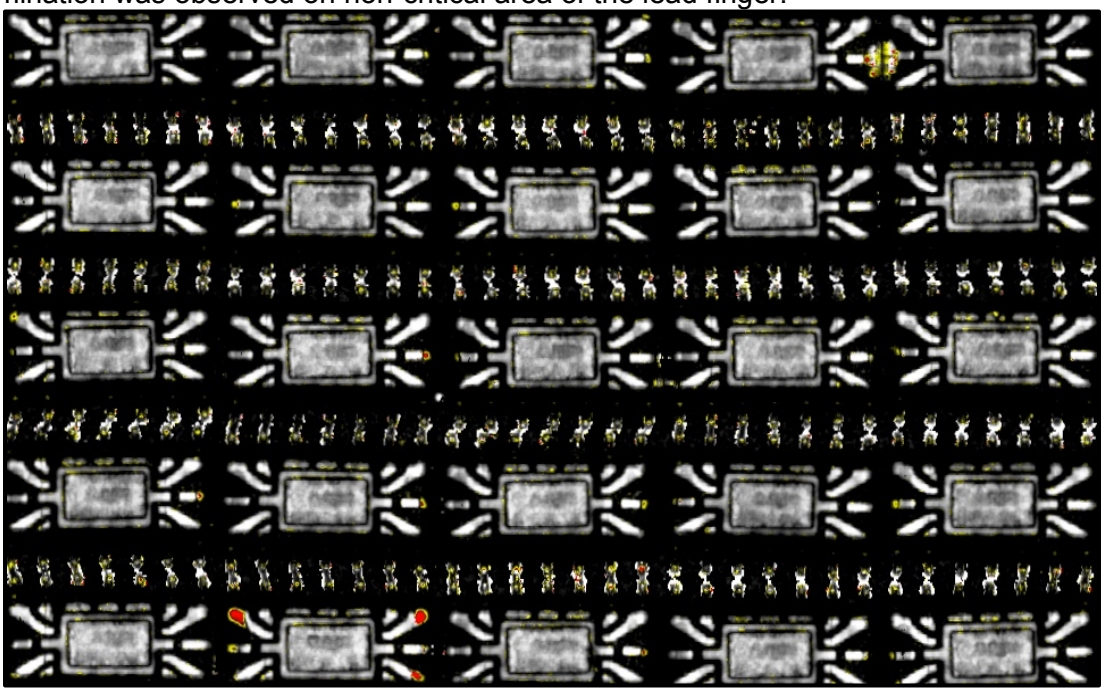


Figure 3: Acoustic Microscopy Image of **control lot** after Moisture Resistance test. Evidence of delamination was observed on non-critical area of the lead finger.

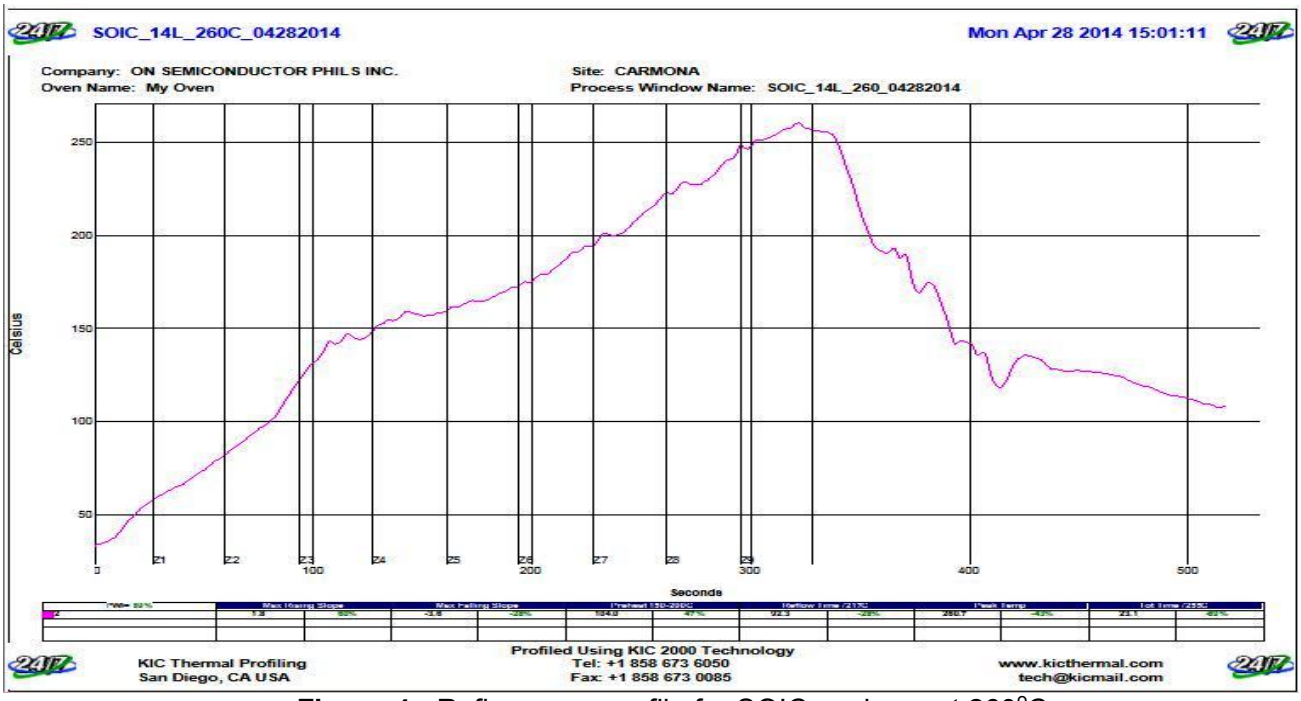


Figure 4: Reflow oven profile for SOIC package at 260°C

6.1.2 THERMO-HUMIDITY TEST

PURPOSE:

The humidity test is used to evaluate the moisture resistance of plastic encapsulated packages. It employs severe conditions of pressure, humidity, and temperature to accelerate the penetration of moisture through the encapsulant or along the interface between the external protective material and the metallic conductors passing through it. In ON Semiconductor, the testing is performed after moisture sensitivity test and temperature cycle preconditioning. These pre-treatments simulate the combination of PCB soldering process, moisture and temperature changes.

REFERENCE STANDARDS:

The tests were run according the JEDEC standard JESD-A118.

RESULT:

No functional failures were observed after stressing. Therefore, package passed Thermo-humidity Test.

TEST SEQUENCE	CONTROL LOT (Rej/SS)	QUAL LOT A (Rej/SS)	QUAL LOT B (Rej/SS)	QUAL LOT C (Rej/SS)
MOISTURE RESISTANCE TEST	0/77	0/77	0/77	0/77
ACOUSTIC MICROSCOPY INSPECTION	0/25[1]	0/25[1]	0/25[1]	0/25[1]
PRECONDITIONING TEMPERATURE CYCLING TEST, 100X AT -55^{O}C/125^{O}C	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT 140^{O}C	0/77	0/77	0/77	0/77
UNBIASED-HAST, 130^{O}C/85% RH FOR 96 HOURS	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT 140^{O}C	0/77	0/77	0/77	0/77

[1] Evidence of delamination was observed on non-critical area of the lead finger.

6.1.3 THERMO-MECHANICAL TEST

PURPOSE:

The thermo-mechanical tests evaluate possible failure mechanisms caused by differences in the thermal expansion coefficient of the different materials (silicon, mold compound, die-attach, etc.) used in package. The testing uses fast temperature changes to evaluate package reliability.

REFERENCE STANDARD:

The test was run according to JEDEC standard JESD-104 condition C (Temperature Cycling).

RESULT:

Two conditions for Thermo-mechanical test were performed in this qual. One was set to -65/150ºC and the other was run at -65/175 ºC.

No functional failures were incurred after 500 and 1000 cycles Thermo-mechanical Test for both TC conditions. However, Scanning Acoustic microscopy after stressing showed occurrence of die paddle and lead finger delamination on some parts after 500 cycles. The

product being evaluated however, does not have provision for down/ground bond and passed bond pull test after 500 and 1000 cycles, thus, package still considered passing.

TEST SEQUENCE FOR TC CONDITION (-65/150°C)	CONTROL LOT (Rej/SS)	QUAL LOT A (Rej/SS)	QUAL LOT B (Rej/SS)	QUAL LOT C (Rej/SS)
MOISTURE RESISTANCE TEST	0/82	0/82	0/82	0/82
FUNCTIONAL TEST AT 140^{O}C	0/82	0/82	0/82	0/82
ACOUSTIC MICROSCOPY INSPECTION	0/25[1]	0/25[1]	0/25[1]	0/25[1]
TEMPERATURE CYCLING TEST, 500X AT -65^{O}C/150^{O}C	0/82	0/82	0/82	0/82
FUNCTIONAL TEST AT 140^{O}C	0/82	0/82	0/82	0/82
ACOUSTIC MICROSCOPY INSPECTION	0/25[2]	0/25[2]	0/25[2]	0/25[2]
BOND-PULL TEST[3]	0/5	0/5	0/5	0/5
TEMPERATURE CYCLING TEST, 1000X AT -65^{O}C/150^{O}C	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT 140^{O}C	0/77	0/77	0/77	0/77
ACOUSTIC MICROSCOPY INSPECTION	0/25[2]	0/25[2]	0/25[2]	0/25[2]
BOND-PULL TEST[3]	0/5	0/5	0/5	0/5

[1]Evidence of delamination was observed on non-critical area of the lead finger
[2]Evidence of delamination was observed on die paddle and critical area of the lead finger but passed Bond Pull test.
[3]Bond pull test was done on 60 wires from 5 parts with 3.0 grams minimum reading as passing criterion and Cpk > 1.33.

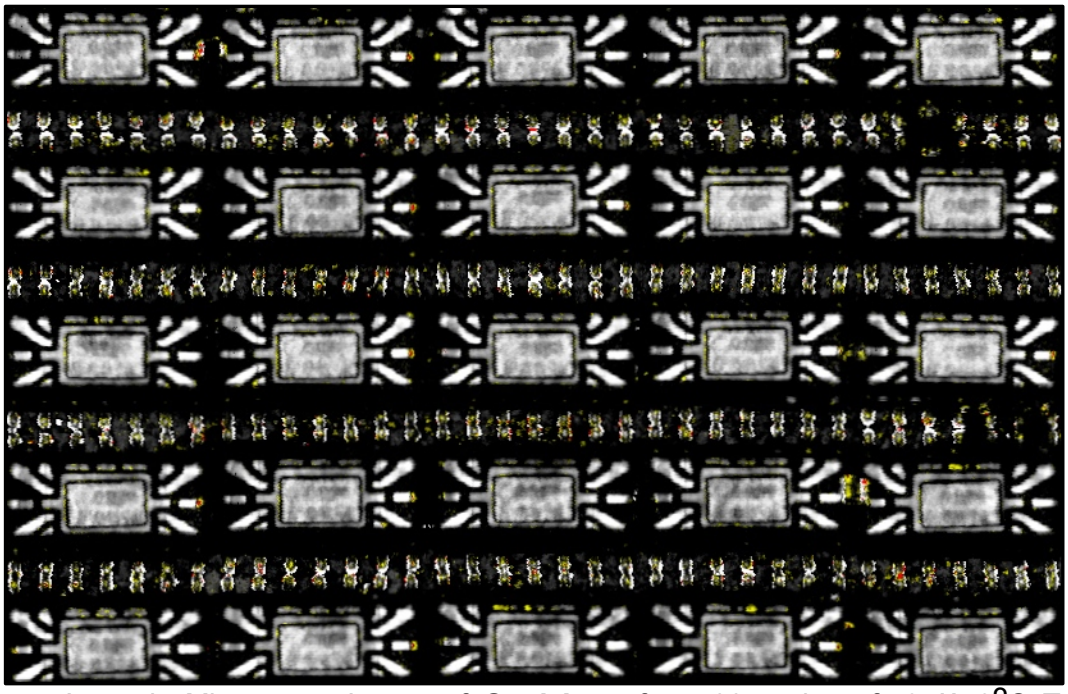


Figure 5: Acoustic Microscopy Image of **Qual Lot** after 500 cycles of **-65/150^{O}C** Temperature Cycling Test. Some parts were observed with delamination on critical area of lead finger but passed bond pull test.

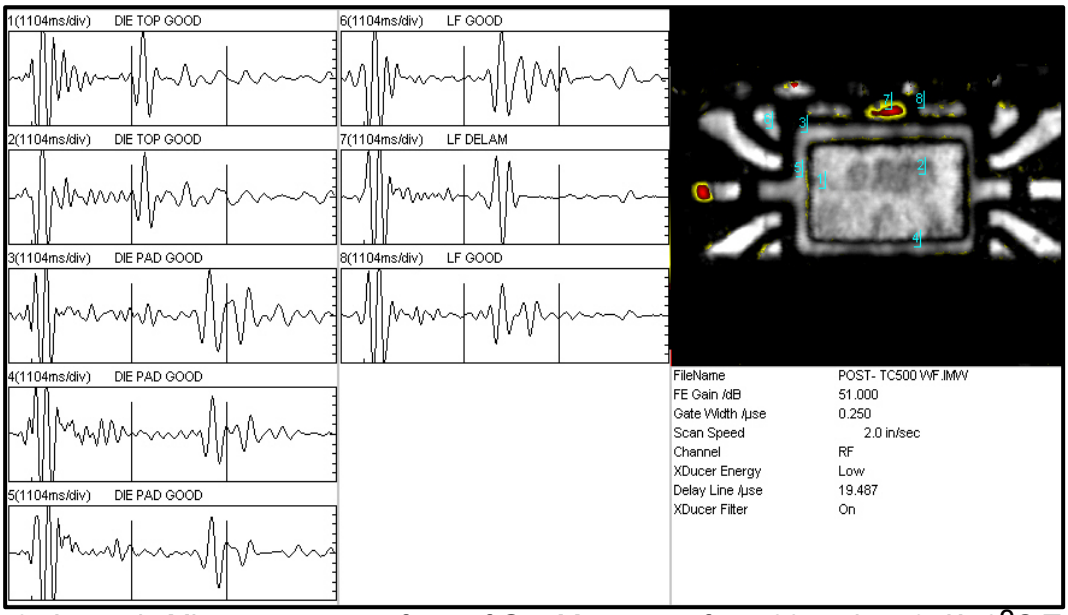


Figure 6: Acoustic Microscopy wave form of **Qual Lot** part after 500 cycles **-65/150^{O}C** Temperature Cycling Test. Delamination was observed on critical area of lead finger but passed bond pull test.

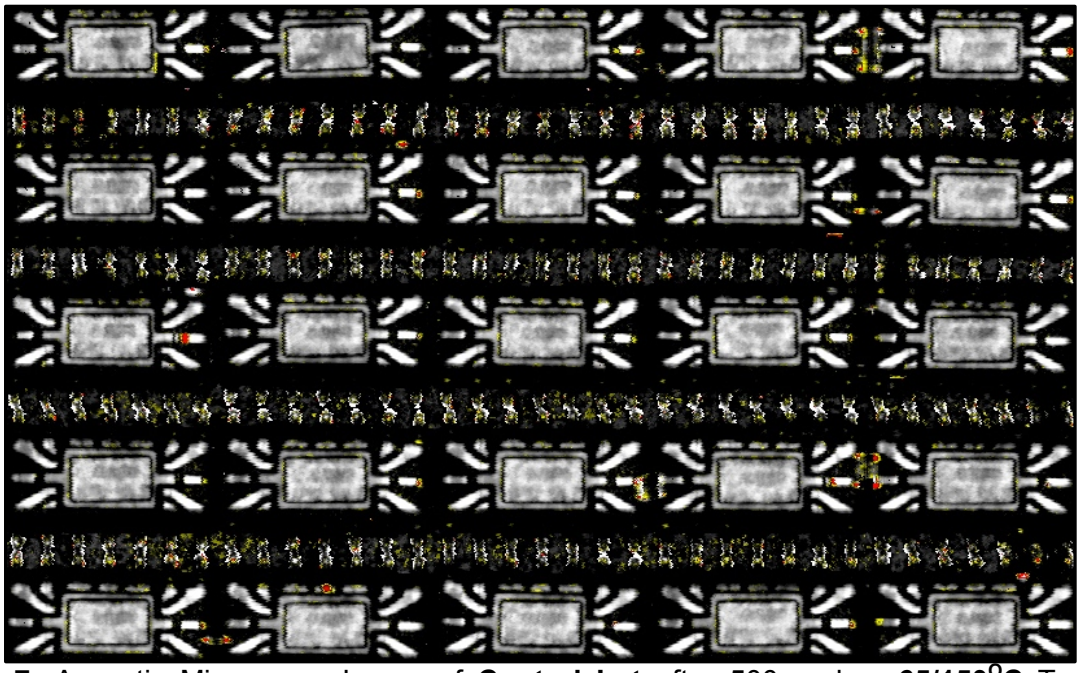


Figure 7: Acoustic Microscopy Image of **Control Lot** after 500 cycles **-65/150^{O}C** Temperature Cycling Test. Some parts were observed with lead finger delamination but passed bond pull test.

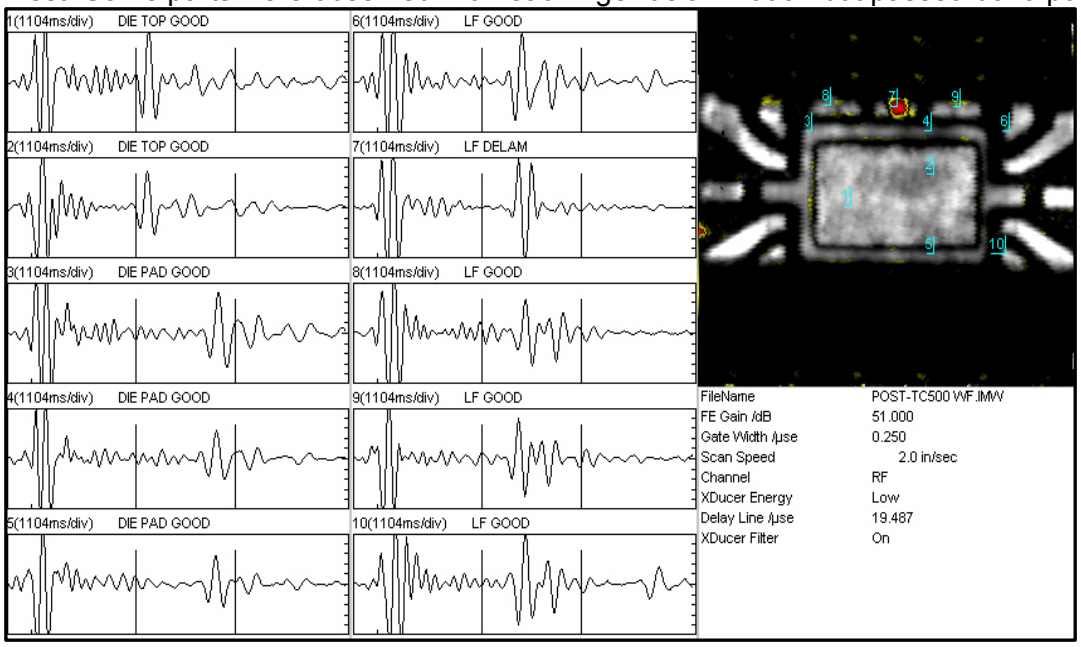


Figure 8: Acoustic Microscopy wave form of **Control Lot** part after 500 cycles **-65/150^{O}C** Temperature Cycling Test. Delamination was observed on critical area of lead finger but passed bond pull test.

RELIABILITY QUALIFICATION

TEST SEQUENCE FOR TC CONDITION (-65/175ºC)	CONTROL LOT (Rej/SS)	QUAL LOT A (Rej/SS)	QUAL LOT B (Rej/SS)	QUAL LOT C (Rej/SS)
MOISTURE RESISTANCE TEST	0/82	0/82	0/82	0/82
FUNCTIONAL TEST AT 140^{O}C	0/82	0/82	0/82	0/82
ACOUSTIC MICROSCOPY INSPECTION	0/25[1]	0/25[1]	0/25[1]	0/25[1]
TEMPERATURE CYCLING TEST, 500X AT -65^{O}C/175^{O}C	0/82	0/82	0/82	0/82
FUNCTIONAL TEST AT 140^{O}C	0/82	0/82	0/82	0/82
ACOUSTIC MICROSCOPY INSPECTION	0/25[2]	0/25[2]	0/25[2]	0/25[2]
BOND-PULL TEST[3]	0/5	0/5	0/5	0/5
TEMPERATURE CYCLING TEST, 1000X AT -65^{O}C/175^{O}C	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT 140^{O}C	0/77	0/77	0/77	0/77
ACOUSTIC MICROSCOPY INSPECTION	0/25[2]	0/25[2]	0/25[2]	0/25[2]
BOND-PULL TEST[3]	0/5	0/5	0/5	0/5

[1]Evidence of delamination was observed on non-critical area of the lead finger
[2] Evidence of delamination was observed on die paddle and critical area of the lead finger but passed Bond Pull test.
[3]Bond pull test was done on 60 wires from 5 parts with 3.0 grams minimum reading as passing criterion and Cpk > 1.33.

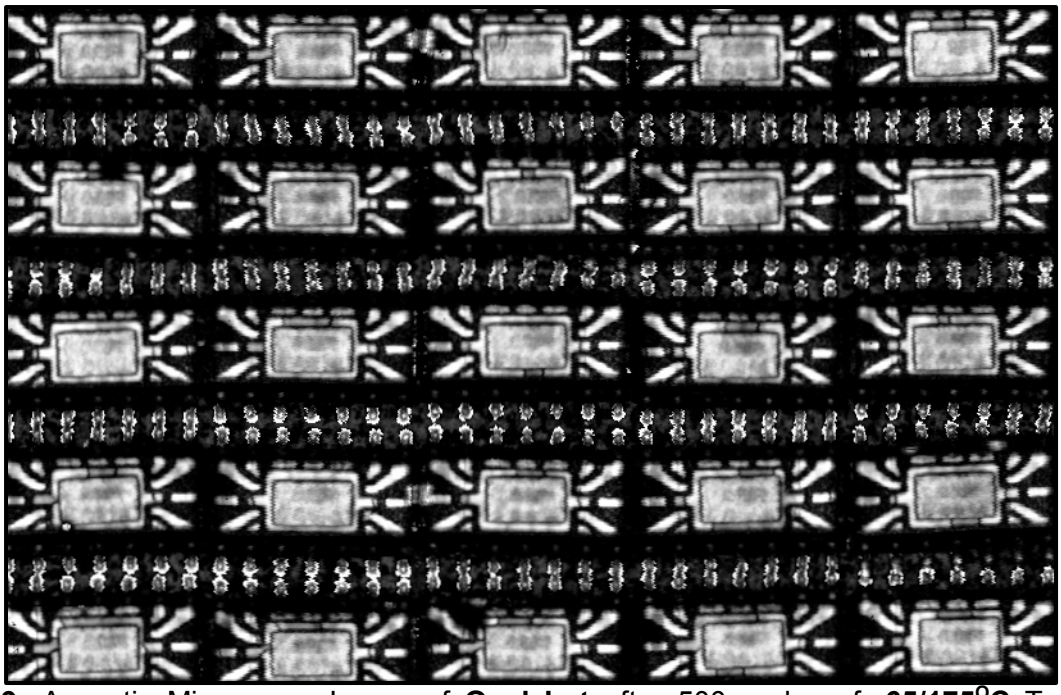


Figure 9: Acoustic Microscopy Image of **Qual Lot** after 500 cycles of **-65/175°C** Temperature Cycling Test. Some parts were observed with delamination on die pad.

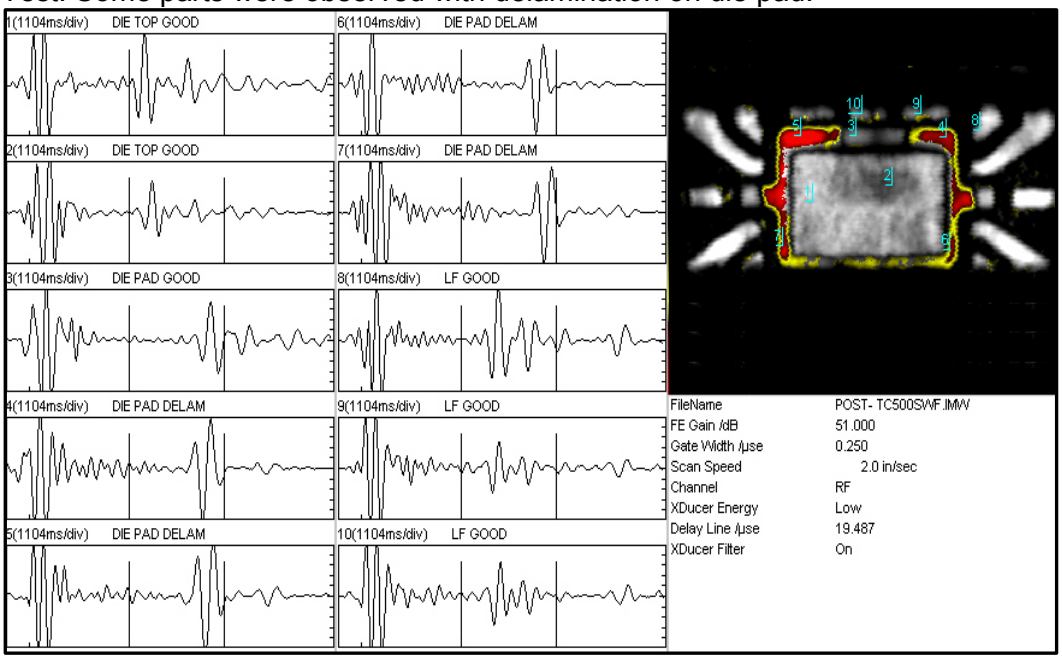


Figure 10: Acoustic Microscopy wave form of **Qual Lot** part after 500 cycles **-65/175°C** Temperature Cycling Test. Delamination was observed on die pad area.

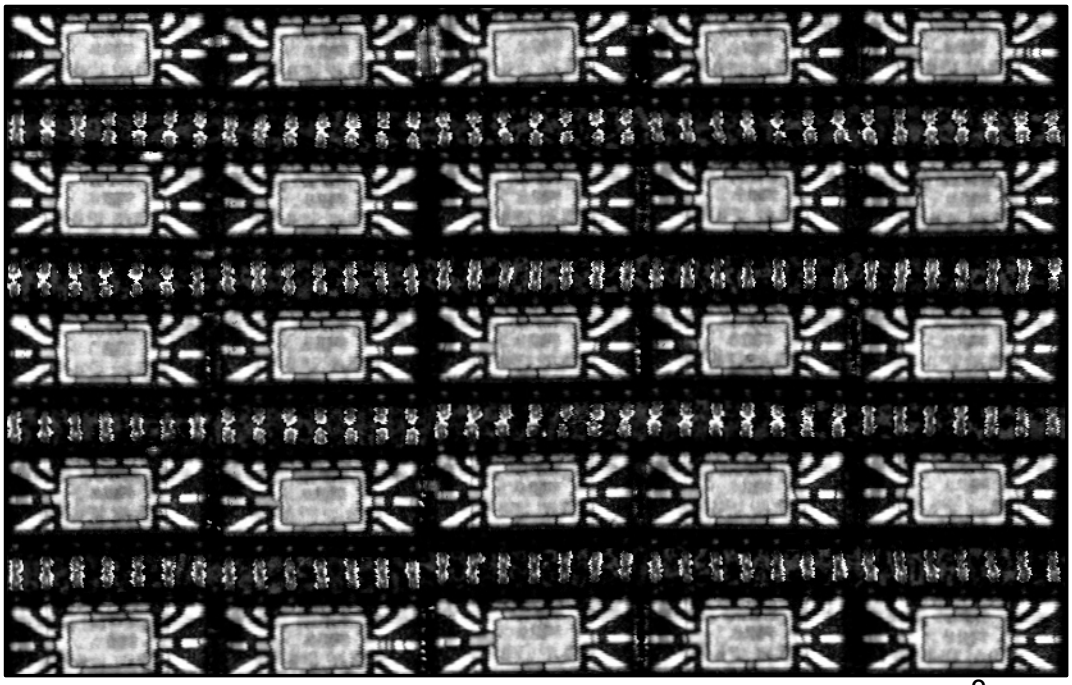


Figure 11: Acoustic Microscopy Image of **Control Lot** after 500 cycles of **-65/175^{O}C** Temperature Cycling Test. Some parts were observed with delamination on die pad.

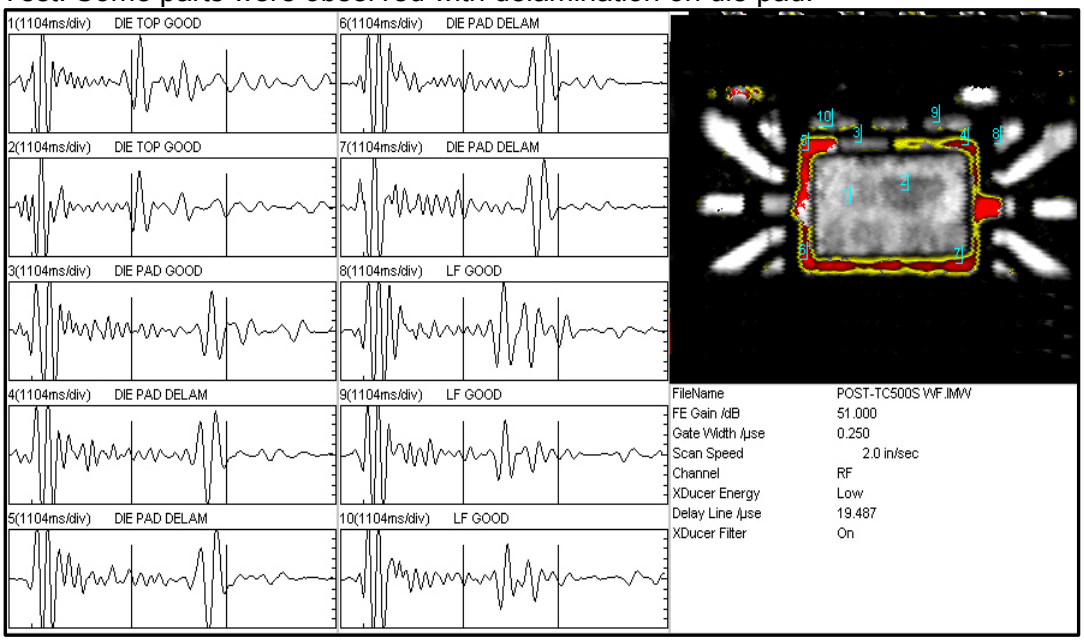


Figure 12: Acoustic Microscopy wave form of **Control Lot** part after 500 cycles **-65/175^{O}C** Temperature Cycling Test. Delamination was observed on die pad.

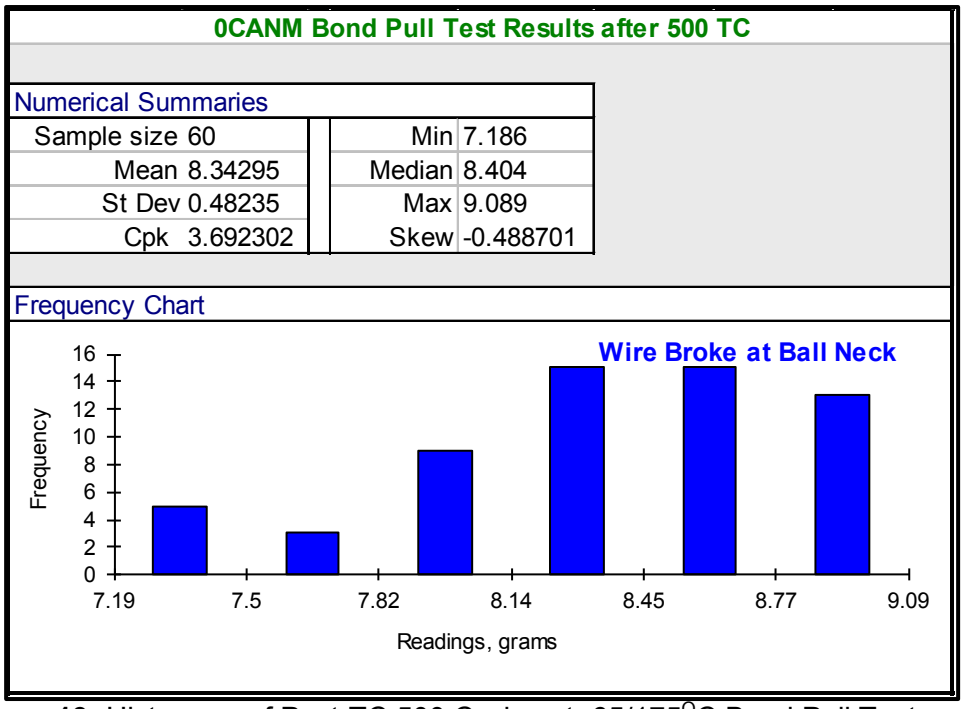


Figure 13: Histogram of Post-TC 500 Cycles at -65/175^{O}C Bond Pull Test result.

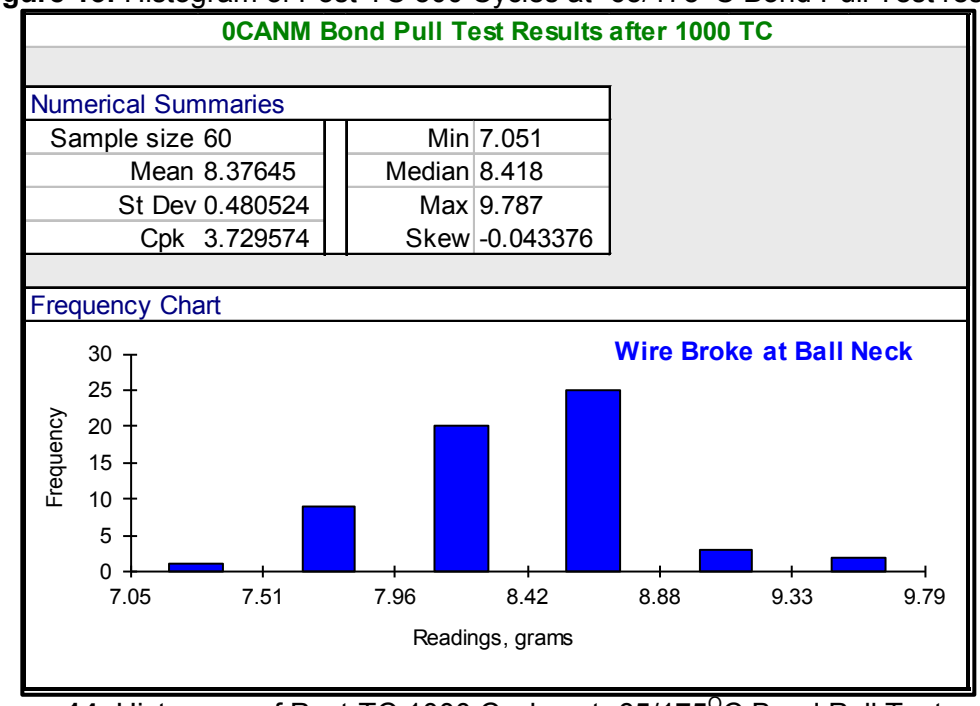


Figure 14: Histogram of Post-TC 1000 Cycles at -65/175^{O}C Bond Pull Test result.

6.1.4 BIASED CORROSION TEST (BIASED-HAST)

PURPOSE:

The Highly-Accelerated Temperature and Humidity Stress Test (HAST) is performed to evaluate the reliability of packaged solid-state devices in a humid environment. It employs the severe conditions of temperature, humidity and bias, which accelerate the penetration of moisture through the external protective material (seal or encapsulant) or along the package interface and the metallic conductors. The test accelerates the corrosion of the metal parts of the product, including the metallization on the surface of the die.

REFERENCE STANDARDS:

The test was conducted according to JEDEC standard JESD-A110-B (Highly-Accelerated Temperature and Humidity Stress Test)

RESULT:

No functional failures were observed after stress. No anomaly was found on the package after stressing upon acoustic microscopy inspection. Therefore, device passed Biased Corrosion Test.

TEST SEQUENCE	CONTROL LOT (Rej/SS)	QUAL LOT A (Rej/SS)	QUAL LOT B (Rej/SS)	QUAL LOT C (Rej/SS)
MOISTURE RESISTANCE TEST	0/77	0/77	0/77	0/77
ACOUSTIC MICROSCOPY INSPECTION	0/25[1]	0/25[1]	0/25[1]	0/25[1]
FUNCTIONAL TEST AT 140^{O}C	0/77	0/77	0/77	0/77
BIASED-HAST, 130^{O}C/85% RH FOR 96 HOURS	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT 140^{O}C	0/77	0/77	0/77	0/77

[1]Evidence of delamination was observed on non-critical area of the lead finger.

.

6.1.5 HIGH TEMPERATURE OPERATING LIFE TEST

PURPOSE:

This test is performed to determine the reliability of devices under operation at high temperature conditions over an extended period of time.

REFERENCE STANDARDS:

The test was conducted according to JEDEC standard JESD22-A108-C (Temperature, Bias and Operating Life).

RESULT:

No functional failures were observed after stress. Device passed High Temperature Operating Life Test.

TEST SEQUENCE	CONTROL LOT (Rej/SS)	QUAL LOT A (Rej/SS)	QUAL LOT B (Rej/SS)	QUAL LOT C (Rej/SS)
FUNCTIONAL TEST AT 140^{O}C	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT - 40^{O}C	0/77	0/77	0/77	0/77
HIGH TEMPERATURE OPERATING LIFE TEST AT 125^{O}C FOR 500H	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT 140^{O}C	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT - 40^{O}C	0/77	0/77	0/77	0/77
HIGH TEMPERATURE OPERATING LIFE TEST AT 125^{O}C FOR 1000H	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT 140^{O}C	6/77[4]	0/77	0/77	0/77
FUNCTIONAL TEST AT - 40^{O}C	0/77	0/77	0/77	0/77

[4] Two O/S (Open/short) and 4 IDDQ (current from drain to drain in quiescent state) failures were incurred after 1000 hours HTOL. FA results showed O/S failures were attributed to EOS (electrical overstress) damage. On the Iddq failures, internal inspection did not show any defect related to backgrind or die sales process (ref. C140610-003).

6.1.6 HIGH TEMPERATURE STORAGE TEST

PURPOSE:

The high temperature storage stress evaluates the package off-chip interconnects. Two typical failures found during this test are:

1.) Ionic contamination of the metallization due to the additives in the molding compound (e.i. flame retardant); this often referred as die corrosion.

2.) Degradation of the Au ball on the Al pads.

REFERENCE STANDARD:

The test was run according to JEDEC standard JESD-103.

RESULT:

No function failures were observed after 500 and 1000 hours high temperature storage test. Therefore, package passed High Temperature Storage Life test.

TEST SEQUENCE	CONTROL LOT (Rej/SS)	QUAL LOT A, B, C (Rej/SS)
FUNCTIONAL TEST AT 140^{O}C	0/77	0/77
HIGH TEMPERATURE STORAGE TEST, 150 ^{O}C FOR 500H	0/77	0/77
FUNCTIONAL TEST AT 140^{O}C	0/77	0/77
HIGH TEMPERATURE STORAGE TEST, 150 ^{O}C FOR 1000H	0/77	0/77
FUNCTIONAL TEST AT 140^{O}C	0/77	0/77

6.1.7 INTERNAL INSPECTION

PURPOSE:

The internal contact tests are done to verify the workmanship of the assembly process before molding (front-end of the assembly process). X-ray and acoustic microscopy (non-destructive tests) were performed first followed by decapsulation, internal visual inspection, and the destructive tests, such as bond pull & bond shear test.

REFERENCE STANDARDS:

AEC-Q100-001 (Bond Shear Test)
Jedec spec J-STD-020 (Scanning Acoustic Microscopy)
Mil-Std-883 Method 2001 (Bond Pull Strength)
Mil-Std-883 Method 2010 (Internal Visual)
Mil-Std-883 Method 2012 (X-ray)

RESULT:

No workmanship problems were detected during the internal contact tests of the SOIC package. All test results are passing the qualification requirements.

TEST SEQUENCE	CONTROL LOT (Rej/SS)	QUAL LOT A (Rej/SS)	QUAL LOT B (Rej/SS)	QUAL LOT C (Rej/SS)
X-RAY INSPECTION	0/15	0/15	0/15	0/15
INTERNAL VISUAL	0/5	0/5	0/5	0/5
BOND PULL TEST[1,3]	0/5	0/5	0/5	0/5
BOND SHEAR TEST[2,3]	0/5	0/5	0/5	0/5

[1]Bond pull test was done on 30 wires from 5 parts with 2.5 grams minimum reading as passing criterion and Cpk>1.33.
[2]Bond shear test was done on 30 ball bonds from 5 parts with 15 grams minimum reading as passing criterion and Cpk>1.33.
[3]Assy generic data was used for bond shear and bond pull tests.

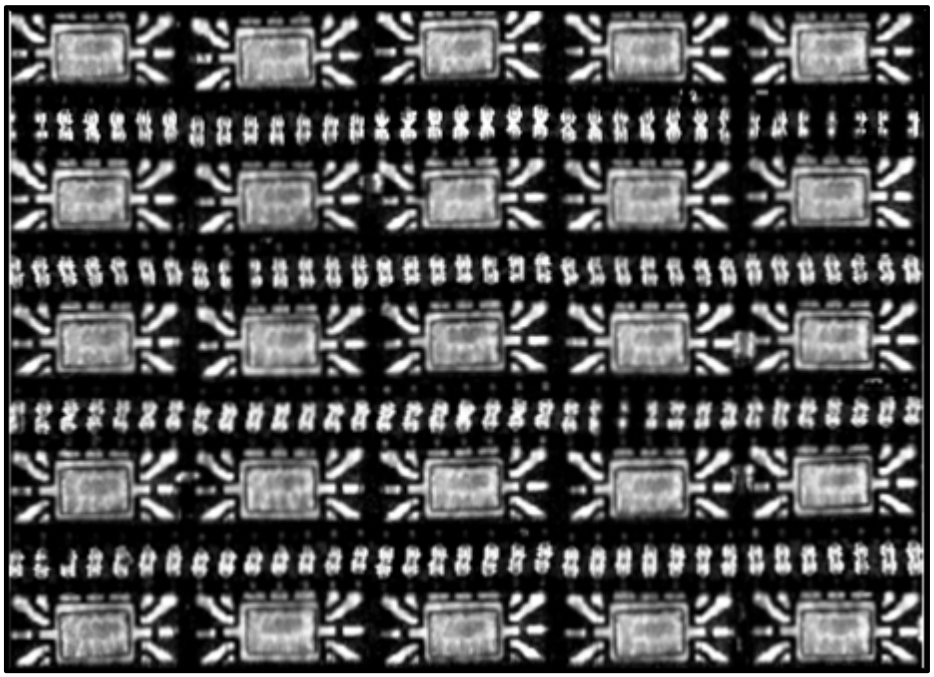


Figure 10: Acoustic Microscopy images of fresh units. No package anomaly was observed.

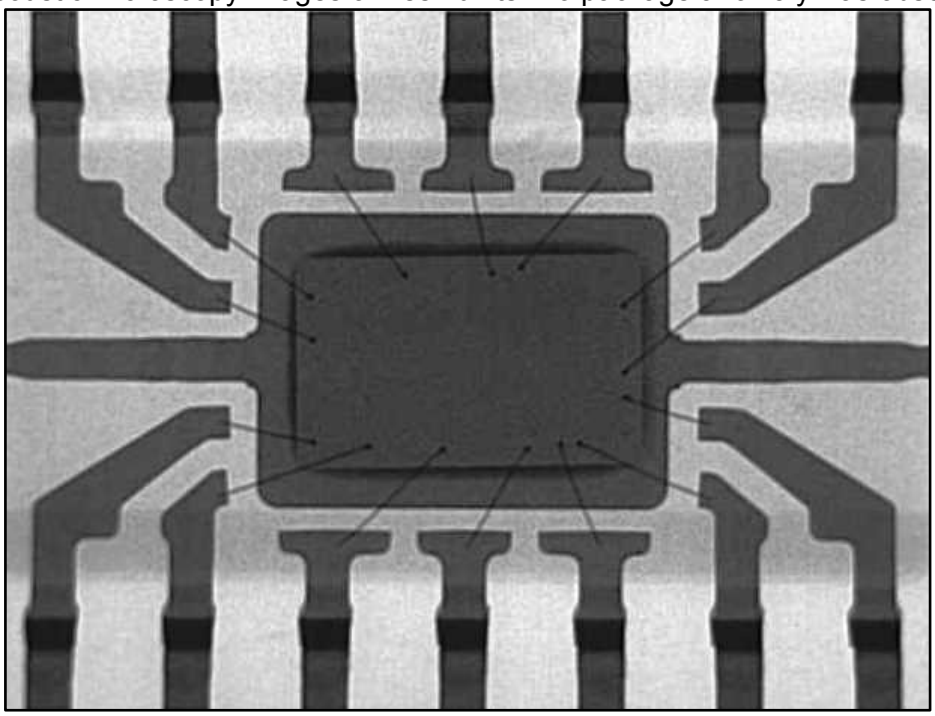


Figure 11: X-ray image of the SOIC package.

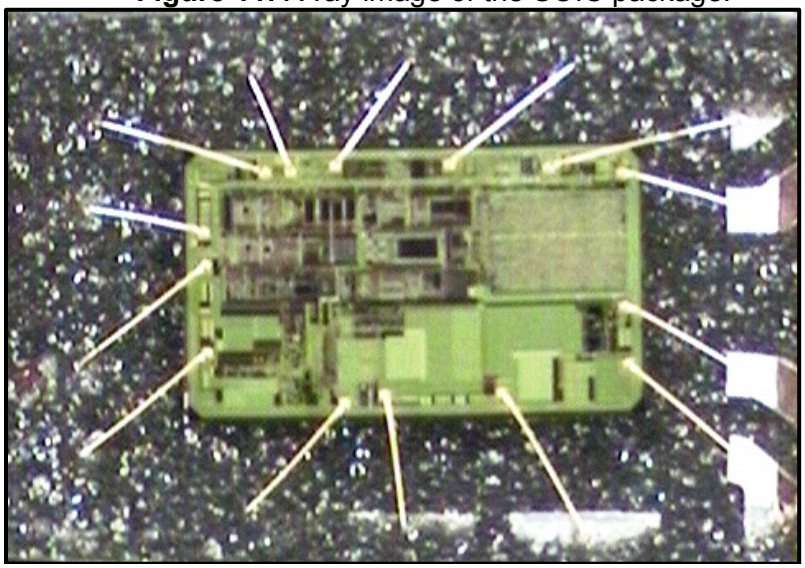


Figure 12: Die photo of SOIC package.

	EBR#98443A			
sample size#	WIREPULL		BALLSHEAR	
	gmf	mode	gmf	mode
MIN	8.046		20.07	
MAX	9.888		29.97	
STDV	0.446050258		2.81151586	
Cpk	**5.147402024**		**1.774843269**	
Ave	8.9971		27.87713793	

Figure 13: Assy generic data of **Qual Lot A** for Bond Pull and Bond Shear tests w/ passing results.

	EBR#98443B			
sample size#	WIREPULL		BALLSHEAR	
	gmf	mode	gmf	mode
MIN	8.43		20.097	
MAX	10.77		27.8	
STDV	0.478820347		1.89726623	
Cpk	**5.409126861**		**2.248849739**	
Ave	9.373896552		22.59672414	

Figure 14: Assy generic data of **Qual Lot B** for Bond Pull and Bond Shear tests w/ passing results.

	EBR#98443C			
sample size#	WIREPULL		BALLSHEAR	
	gmf	mode	gmf	mode
MIN	8.21		24.32	
MAX	10.013		38.84	
STDV	0.462277333		3.24679824	
Cpk	**5.056848996**		**2.447539416**	
Ave	9.2938		29.07413793	

Figure 15: Assy generic data of **Qual Lot C** for Bond Pull and Bond Shear tests w/ passing results.

6.1.8 EXTERNAL INSPECTION

PURPOSE:

The external workmanship tests are done to verify external quality and workmanship of the back-end of the assembly process.

REFERENCE STANDARDS:

Mil-Std-883 Method 2009 (External Visual)

RESULT:

No workmanship problems were observed during the external tests of LQFP package. All samples passed solderability and physical dimensional inspection.

TEST SEQUENCE	SAMPLE SIZE	CONTROL LOT	QUAL LOT A	QUAL LOT B	QUAL LOT C
EXTERNAL VISUAL	ALL	0/487	0/487	0/487	0/487

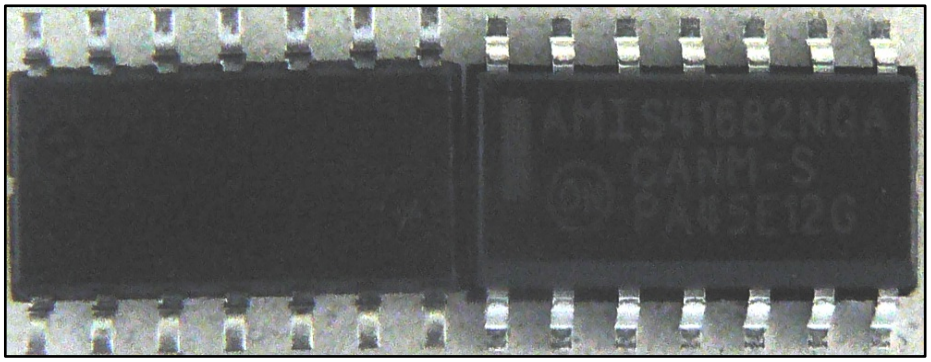


Figure 16: Bottom (left-side) and top (right-side) view of the SOIC package.

RELIABILITY QUALIFICATION

ON Semiconductor Back Grind/Die Sales Qualification

ON Semiconductor Philippines

Package Code : **LQFP**
Assembly Location : **Amkor Technology Korea**

Report ID	:	**0SHIA_DP_A01**
Qual Version	:	**A01**
RMS No.	:	**O23431**
Date Released	:	**June 20, 2014**
Authored by	:	**ANDY F. ESTEVA** Reliability Engineer
Approved by	:	**JOSEPHINE GUEVARRA** OSPI and SBN Reliability Engineering Manager
Approved by	:	**DANIEL VANDERSTRAETEN** Assembly Reliability Manager

RELIABILITY QUALIFICATION

Table of Contents

1.0 EXECUTIVE SUMMARY

As part of the ON Semiconductor Philippines (OSPI) Back Grind/Die Sales line project release, qualification was done using an LQFP package as qualification vehicle for the various reliability tests. This is to assess the reliability of the products processed using the newly installed back grind/die sales operations in OSPI. The qualification has concluded with passing results. The qualification was run according to ON Semiconductor Specification 12MON81348F, ON Semiconductor Assembly Reliability Qualification.

The qualification was initiated to qualify the associated processes and the newly acquired equipment's for the newly installed in-house back grind/die sales operations. However, tape and reel process and machine for die sales was not covered, thus, defects induced by die sales' tape and reel process were not covered by the reliability qualification.

ON Semiconductor releases the package and materials set under consideration for dry pack level 3 of IPC/JEDEC standard J-STD-020 (Moisture/Reflow Sensitivity Classification for Non-Hermetic Solid State Surface Mount Devices). Solder temperature used during the qualification was 260°C.

RELIABILITY QUALIFICATION

2.0 OBJECTIVE

This project aims to qualify the new back grind/die sales line installed in OSPI.
The reliability qualification was intended to assess the reliability of the products processed on the newly installed back grind and die sales in OSPI. A representative part using a LQFP package was selected as one of the qualification vehicles to represent the automotive and Mil/AERO products, the temperature cycle was extended to 1000 cycles. Solder reflow temperature used during qualification was 260^{o}C peak temperature.

Wafers for evaluation were thinned and sawn in OSPI and shipped to Amkor Korea (ATK) in metal ring frame, while wafers for control were shipped in wafer boat for wafer thinning and assembly in ATK.

3.0 VERSION HISTORY

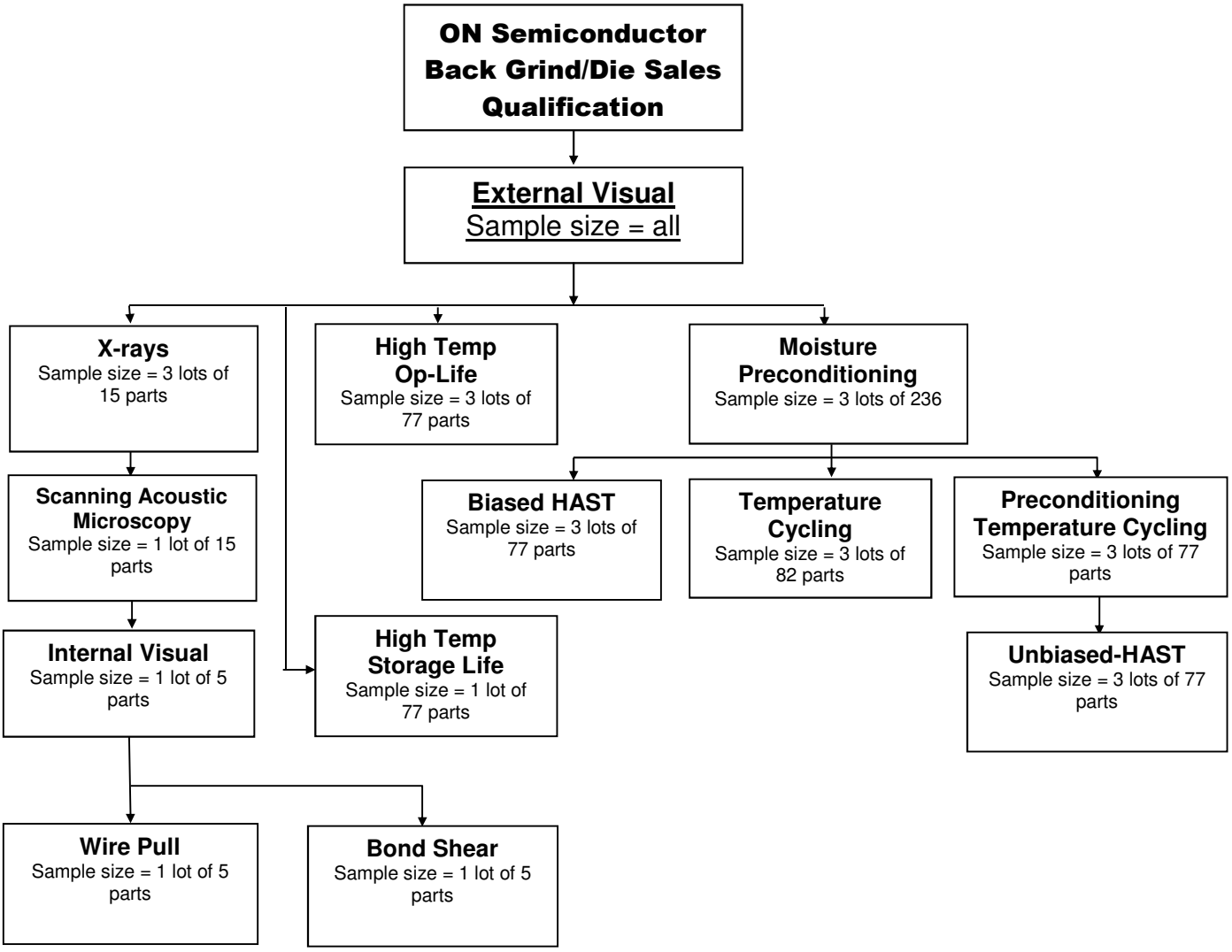
Version	Date	List of Modification
A01	20-June-2014	- OSPI back grind and die sales insourcing qualification_LQFP

4.0 TEST VEHICLE IDENTIFICATION

	QUAL LOTS	CONTROL LOT
Device Identification	: 0SHIA-005	0SHIA-005
Lot Identification	: D14780.1, D14781.1, D14782.1	D14779.1
Lot Assembly Tracecode	: 1412AHQ, 1412AHR, 1412AHS	1412AHP
Die-attach Material	: ABLEBOND 3230	ABLEBOND 3230
Mold compound	: EMC-G700L	EMC-G700L
Die Coat Material	: N/A	N/A
Leadframe Material	: E64T DR 14B HD	E64T DR 14B HD
Lead Finish	: Matte Tin	Matte Tin
Lot Assembly House	: Amkor Technology Korea	Amkor Technology Korea
Lot Backgrind House	: ON Semiconductor Phils.	Amkor Technology Korea
Lot wafer saw House	: ON Semiconductor Phils.	Amkor Technology Korea
Package pin count	: 100 LQFP	100 LQFP
Body Size	: 14 x 14 mm	14 x 14 mm
Pad size	: 9.5 x 9.5 mm	9.5 x 9.5 mm
Die Size	: 8.0 x 7.76 mm	8.0 x 7.76 mm
Package marking	: LASER	LASER
Wire bond method	: Ball – Stitch	Ball - Stitch
Wire bond material	: Gold 1.0 mils	Gold 1.0 mils

5.0 QUALIFICATION REQUIREMENTS

QUALIFICATION FLOW



TEST CONDITIONS AND EQUIPMENT LIST

TEST	CONDITIONS	CHECKPOINTS	INSTRUMENT/ EQUIPMENT
Moisture Preconditioning • Bake • Humidity Soak • Reflow	 125°C 30°C / 60% RH 260°C	 24 hrs 192 hrs 3 cycles	 Blue M OV-500C-2 Blue M CFR-7752B Heller 1809EXL
Scanning Acoustic Microscopy	Not Applicable	Pre and Post MSL, Post TC	SONOSCAN CSAM Series D91000
Temperature Cycling	-65°C / 150°C	500, 1000 cycles	Thermotron
High Temperature Bake	150°C	500 hrs, 1000 hrs	Blue M OV-500C-2
High Temperature Op-life	125°C	1000 hrs	AMT 14000
Biased HAST	130°C / 85°C RH	96 hrs	HIRIYAMA PC-422R8
Unbiased HAST	130°C / 85°C RH	96 hrs	HIRIYAMA PC-422R8
Bond Pull Test	Not Applicable	Not Applicable	Intellitest FA1800
Bond Shear Test	Not Applicable	Not Applicable	Intellitest FA1800
Electrical Testing	SW3, -40, 125°C	Not Applicable	Tester: SZ
External Visual	Not Applicable	Not Applicable	Nikon AFX-II
X-ray Inspection	Not Applicable	Not Applicable	YTX-300

6.0 DATA AND RESULTS

6.1.1 MOISTURE RESISTANCE TEST

PURPOSE:

The moisture sensitivity test evaluates the sensitivity of surface mount packages to humidity uptake during storage on the shelf before soldering on PCB board at customer's site. The failure mode found is known as the popcorn effect. Moisture sensitivity level 3 conditions with 260°C peak temperatures during solder reflow simulation were observed in the conduct of the test. The solder technique used was IR/Convection reflow.

REFERENCE STANDARD:

The test was run according to IPC/JEDEC standard J-STD-020D (Moisture/Reflow Sensitivity Classification for Non Hermetic Solid State Surface Mount Devices).

RESULT:

No functional failures were incurred on qualification lots after Moisture Resistance Test. The control lot however, incurred die pad delamination on some parts. Likewise, no physical anomaly was observed on the packages before and after stressing upon acoustic microscopy inspection. Hence, the package passed Moisture Resistance Test.

RELIABILITY QUALIFICATION

TEST SEQUENCE	CONTROL LOT (Rej/SS)	QUAL LOT A (Rej/SS)	QUAL LOT B (Rej/SS)	QUAL LOT C (Rej/SS)
ACOUSTIC MICROSCOPY INSPECTION	0/236	0/236	0/236	0/236
BAKE DRY, 24 HOURS AT 125^{O}C	0/236	0/236	0/236	0/236
MOISTURE ABSORPTION, 30^{O}C/60% RH FOR 192 HOURS	0/236	0/236	0/236	0/236
REFLOW SOLDERING, 3X AT 260^{O}C	0/236	0/236	0/236	0/236
FUNCTIONAL TEST AT 125^{O}C	0/236	0/236	0/236	0/236
ACOUSTIC MICROSCOPY INSPECTION	0/75[1]	0/75	0/75	0/75

[1]With Die Pad delamination was observed on control lot, however the part has no provision for down/ground bond.

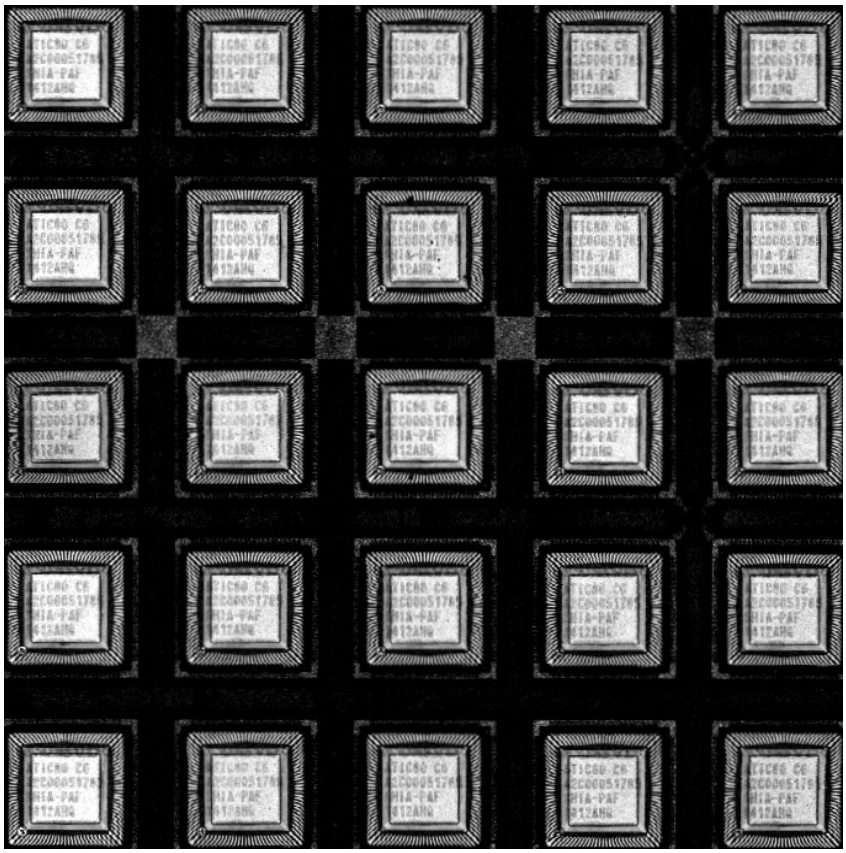


Figure 1: Acoustic Microscopy Image prior Moisture Resistance test. No delamination observed in all package interfaces.

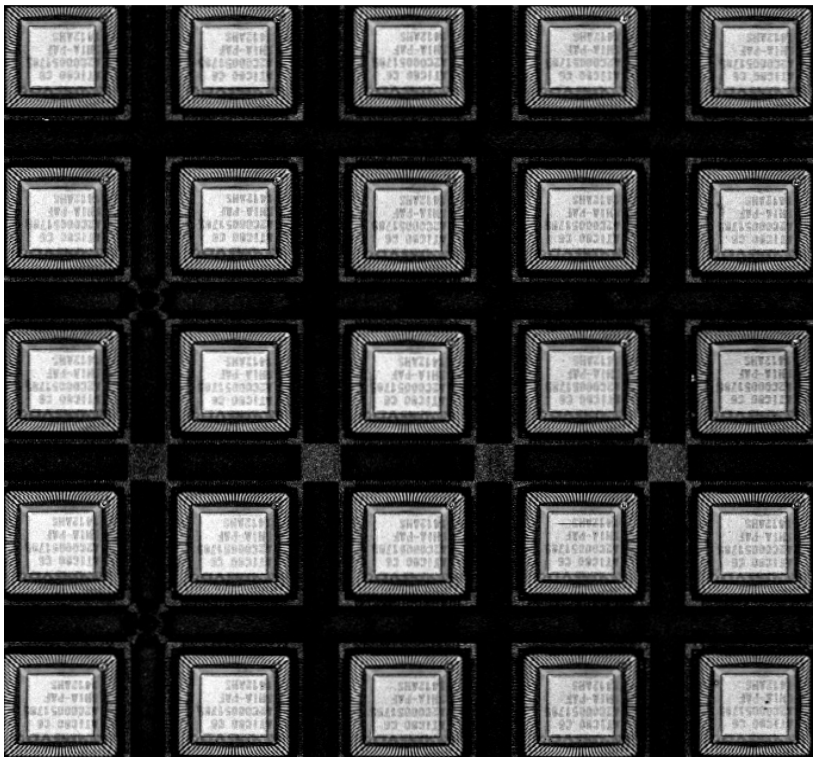


Figure 2: Acoustic Microscopy Image after Moisture Resistance test of qualification lot. No package anomaly was observed.

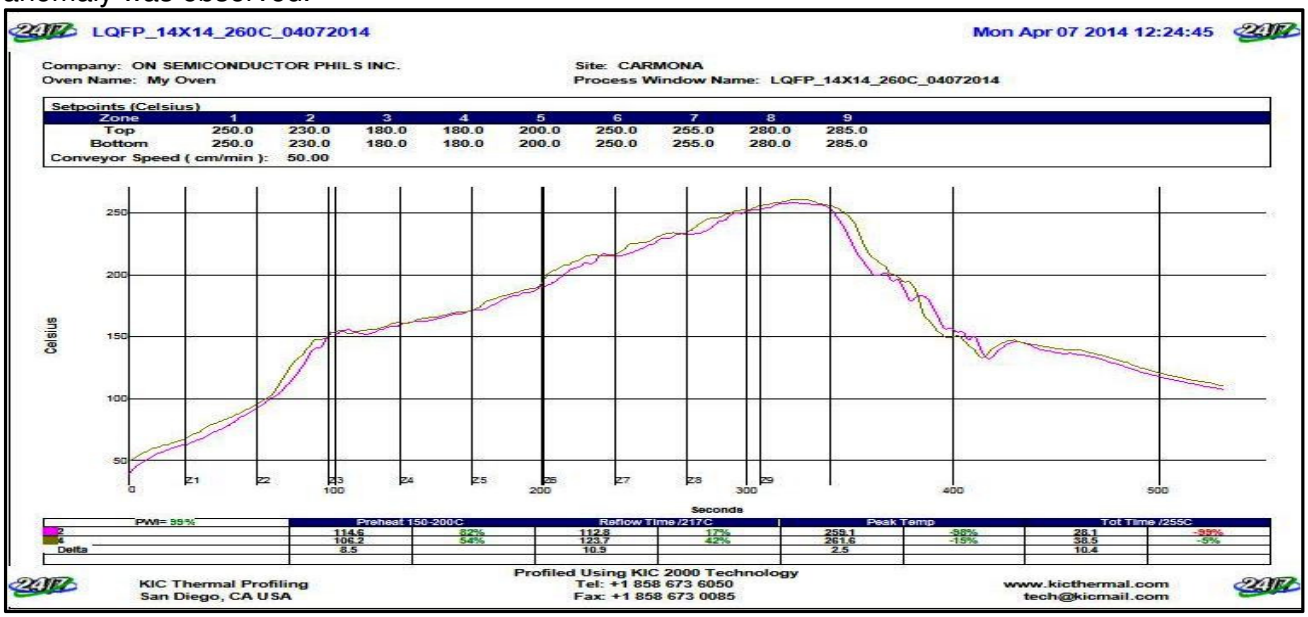


Figure 3: Reflow oven profile for LQFP package at 260°C

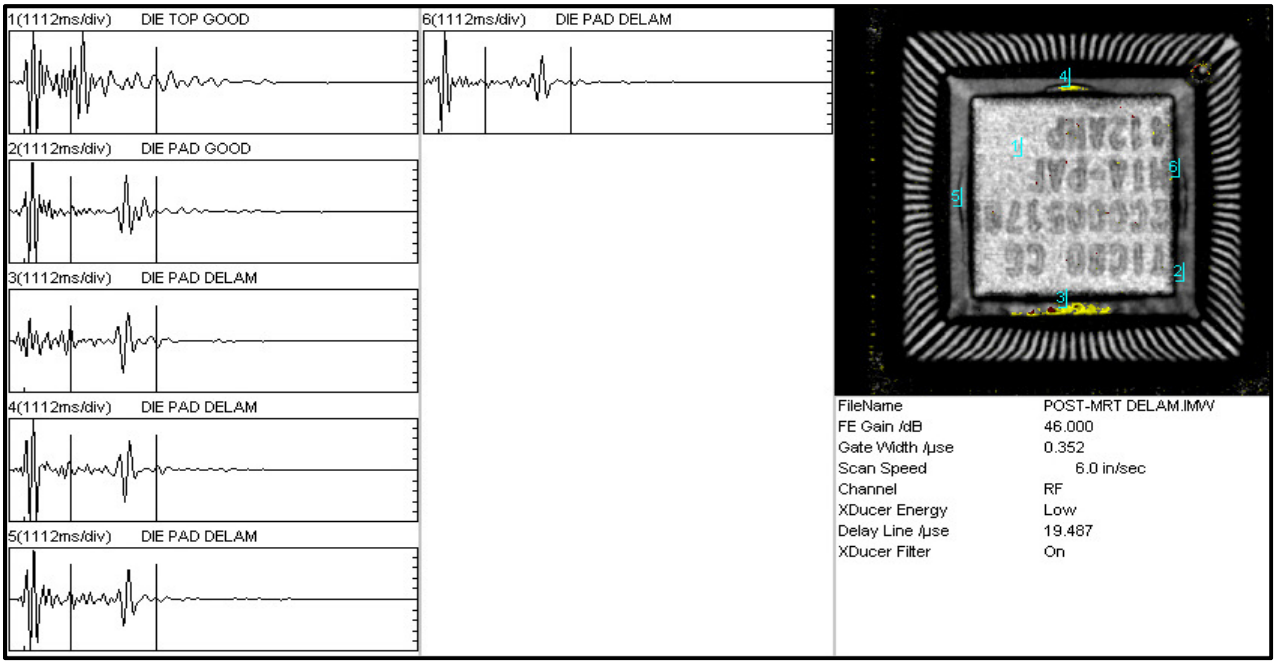


Figure 4: Acoustic Microscopy waveform of part from **Control lot** with die pad delamination after moisture resistance Test.

6.1.2 THERMO-HUMIDITY TEST

PURPOSE:

The humidity test is used to evaluate the moisture resistance of plastic encapsulated packages. It employs severe conditions of pressure, humidity, and temperature to accelerate the penetration of moisture through the encapsulant or along the interface between the external protective material and the metallic conductors passing through it. In ON Semiconductor, the testing is performed after moisture sensitivity test and temperature cycle preconditioning. These pre-treatments simulate the combination of PCB soldering process, moisture and temperature changes.

REFERENCE STANDARDS:

The tests were run according the JEDEC standard JESD-A118.

RESULT:

No functional failures were observed after stressing. Therefore, package passed Thermo-humidity Test.

TEST SEQUENCE	CONTROL LOT (Rej/SS)	QUAL LOT A (Rej/SS)	QUAL LOT B (Rej/SS)	QUAL LOT C (Rej/SS)
MOISTURE RESISTANCE TEST	0/77	0/77	0/77	0/77
ACOUSTIC MICROSCOPY INSPECTION	0/25[1]	0/25	0/25	0/25
PRECONDITIONING TEMPERATURE CYCLING TEST, 100X AT -55^{O}C/125^{O}C	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT 125^{O}C	0/77	0/77	0/77	0/77
UNBIASED-HAST, 130^{O}C/85% RH FOR 96 HOURS	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT 125^{O}C	0/77	0/77	0/77	0/77

[1]With Die Pad delamination was observed on control lot, however the part has no provision for down/ground bond.

6.1.3 THERMO-MECHANICAL TEST

PURPOSE:

The thermo-mechanical tests evaluate possible failure mechanisms caused by differences in the thermal expansion coefficient of the different materials (silicon, mold compound, die-attach, etc.) used in package. The testing uses fast temperature changes to evaluate package reliability.

REFERENCE STANDARD:

The test was run according to JEDEC standard JESD-104 condition C (Temperature Cycling).

RESULT:

No functional failures were incurred after 500 and 1000 cycles Thermo-mechanical Test. Acoustic microscopy after stressing however showed occurrence of die pad delamination on some parts of qualification lots and control lot after 500 cycles. The part however, does not have provision for down/ground bond thus, package still considered passing.

RELIABILITY QUALIFICATION

TEST SEQUENCE	CONTROL LOT (Rej/SS)	QUAL LOT A (Rej/SS)	QUAL LOT B (Rej/SS)	QUAL LOT C (Rej/SS)
MOISTURE RESISTANCE TEST	0/82	0/82	0/82	0/82
FUNCTIONAL TEST AT 125^{O}C	0/82	0/82	0/82	0/82
ACOUSTIC MICROSCOPY INSPECTION	0/25[1]	0/25	0/25	0/25
TEMPERATURE CYCLING TEST, 500X AT -65^{O}C/150^{O}C	0/82	0/82	0/82	0/82
FUNCTIONAL TEST AT 125^{O}C	0/82	0/82	0/82	0/82
ACOUSTIC MICROSCOPY[1] INSPECTION	0/25[1]	0/25[1]	0/25[1]	0/25[1]
BOND-PULL TEST[2]	0/5	0/5	0/5	0/5
TEMPERATURE CYCLING TEST, 1000X AT -65^{O}C/150^{O}C	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT 125^{O}C	0/77	0/77	0/77	0/77
ACOUSTIC MICROSCOPY[1] INSPECTION	0/25[1]	0/25[1]	0/25[1]	0/25[1]
BOND-PULL TEST[2]	0/5	0/5	0/5	0/5

[1]With Die Pad delamination was observed, however the part has no provision for down/ground bond.
[2]Bond pull test was done on 60 wires from 5 parts with 3.0 grams minimum reading as passing criterion and Cpk > 1.33.

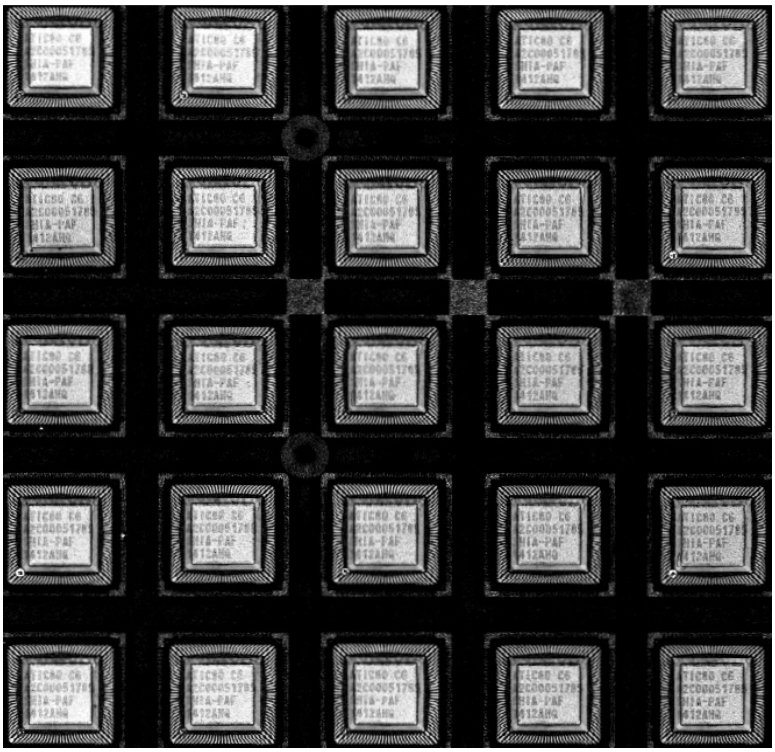


Figure 5: Acoustic Microscopy Image after 500 cycles Temperature Cycling Test. Some parts were observed with die pad delamination.

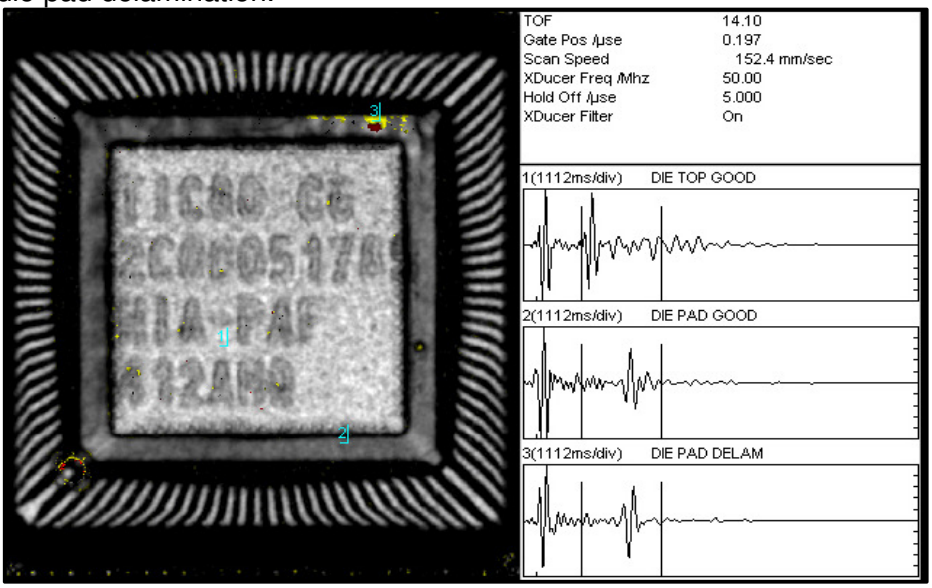


Figure 6: Acoustic Microscopy waveform of part of **Qual lot** with die pad delamination after 500 cycles Temperature Cycling Test.

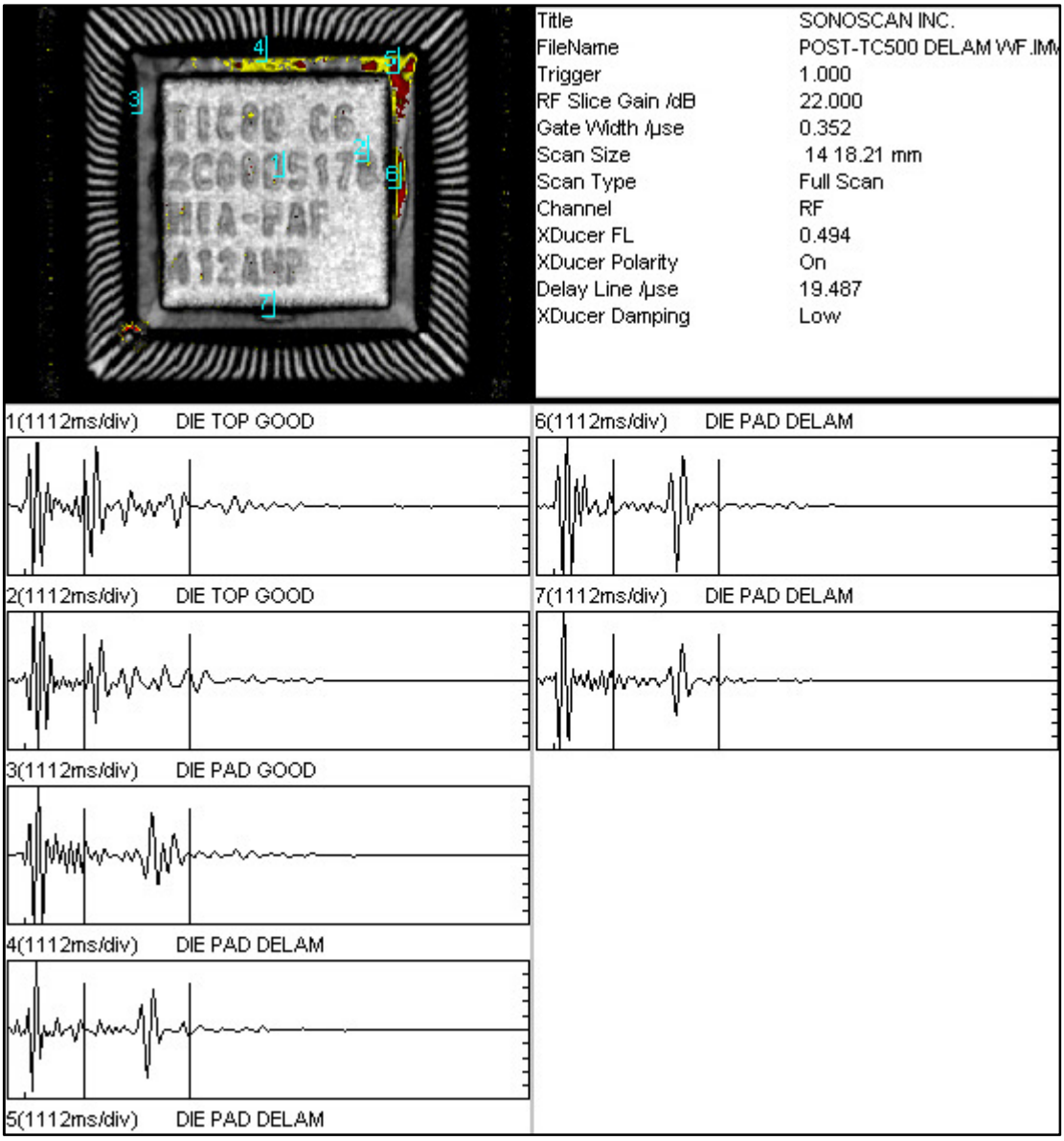


Figure 7: Acoustic Microscopy waveform of part of **Control lot** with die pad delamination after 500 cycles Temperature Cycling Test.

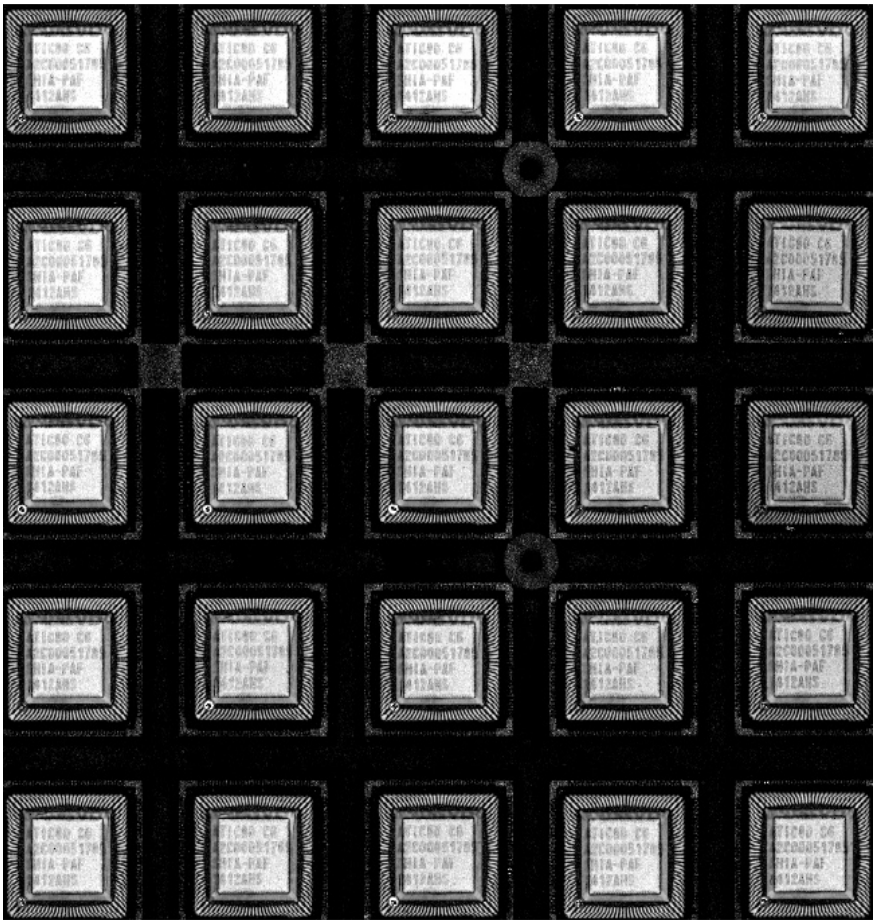


Figure 8: Acoustic Microscopy waveform of part with die pad delamination after 1000 cycles Temperature Cycling Test.

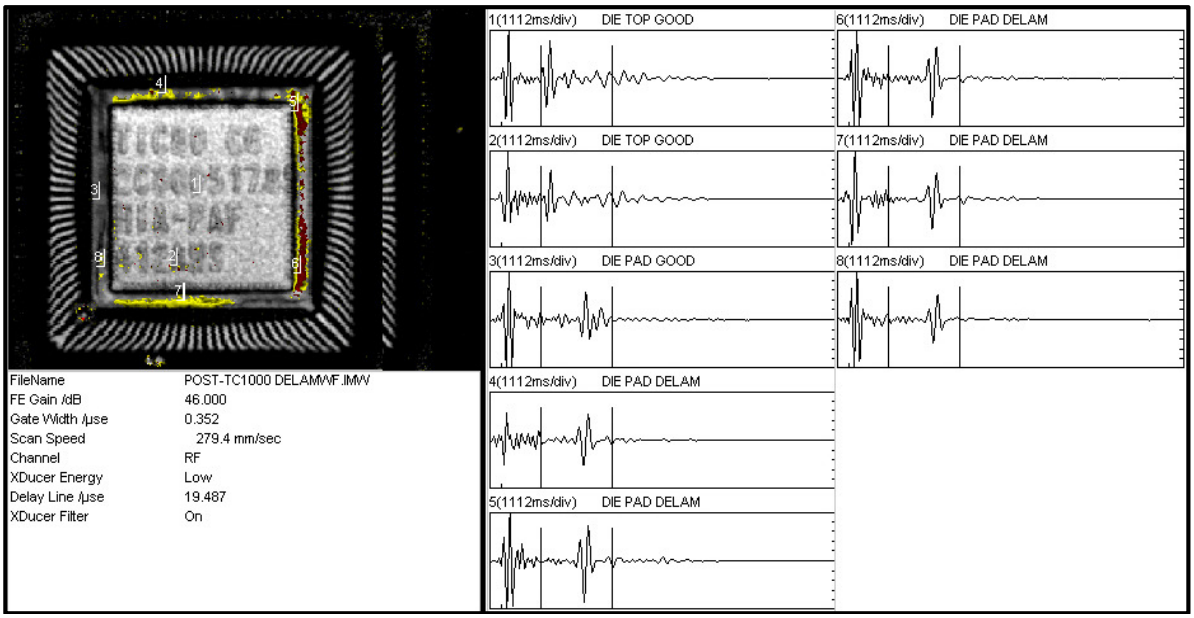


Figure 9: Acoustic Microscopy waveform of part **Qual lot** with die pad delamination after 1000 cycles Temperature Cycling Test.

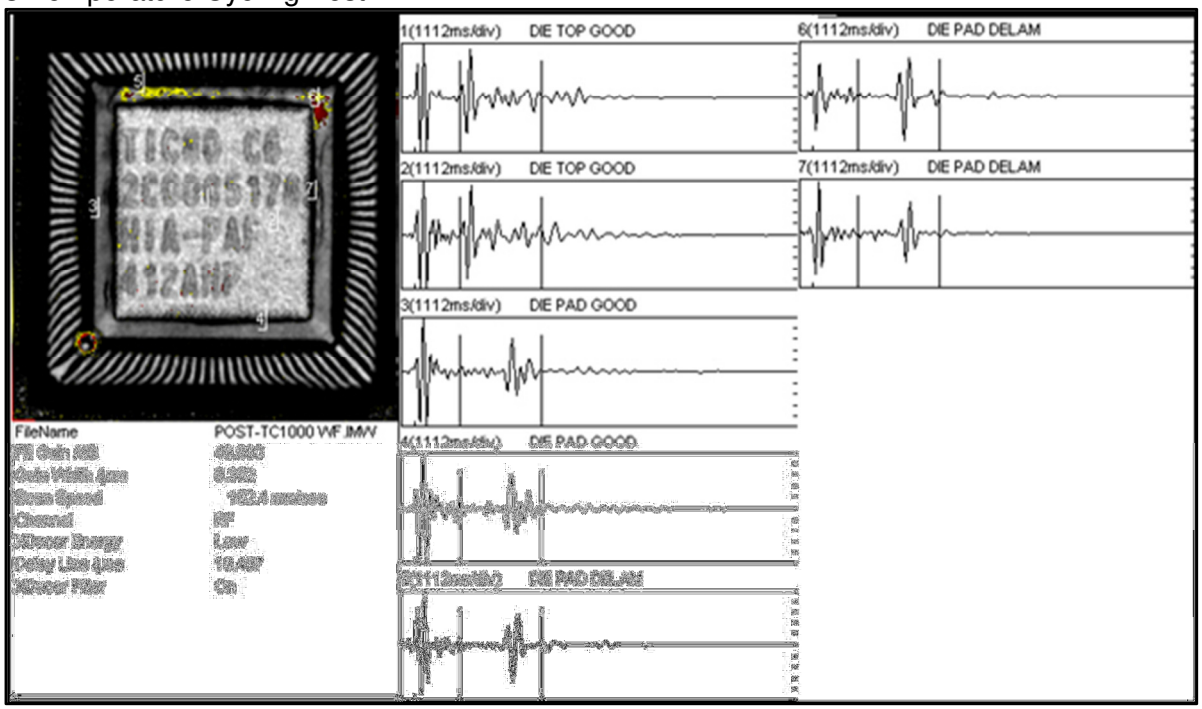


Figure 10: Acoustic Microscopy waveform of part **Control lot** with die pad delamination after 1000 cycles Temperature Cycling Test.

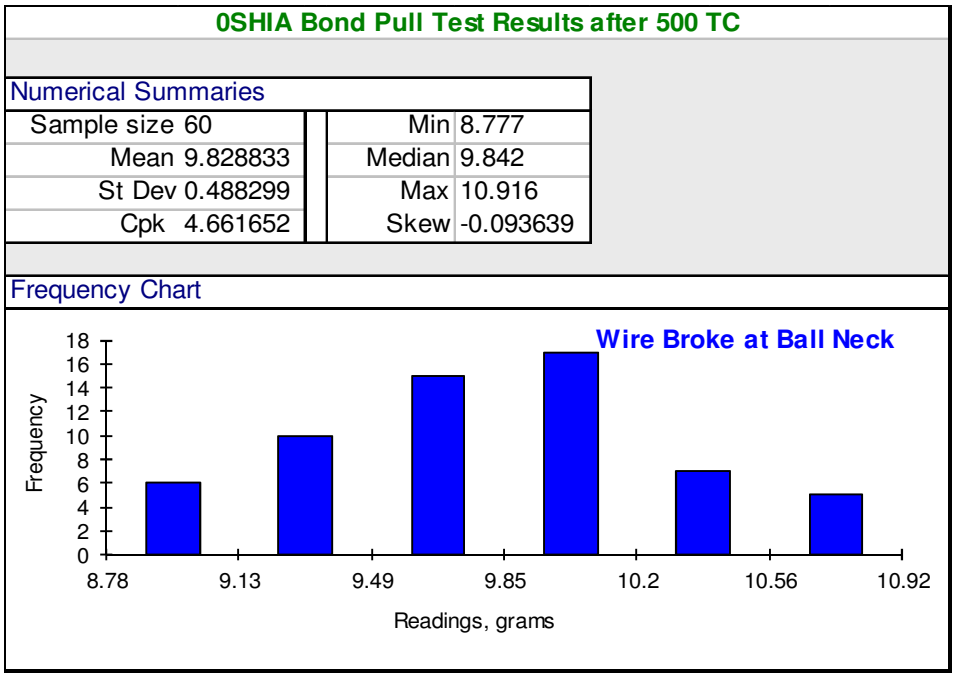


Figure 11: Histogram of Post-TC 500 Cycles Bond Pull Test result.

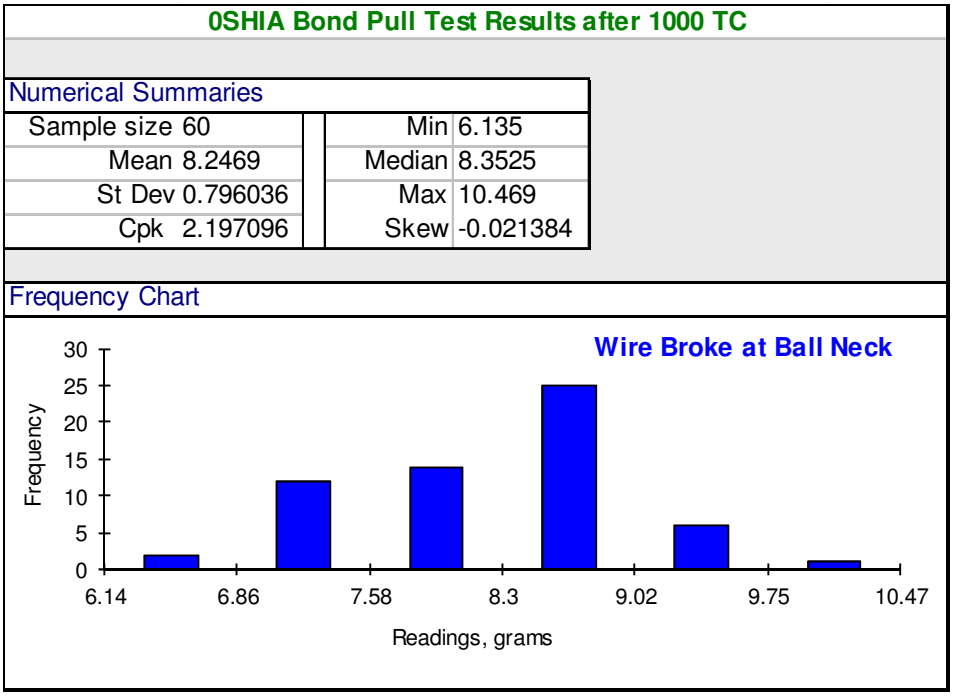


Figure 12: Histogram of Post-TC 1000 Cycles Bond Pull Test result.

6.1.4 BIASED CORROSION TEST (BIASED-HAST)

PURPOSE:

The Highly-Accelerated Temperature and Humidity Stress Test (HAST) is performed to evaluate the reliability of packaged solid-state devices in a humid environment. It employs the severe conditions of temperature, humidity and bias, which accelerate the penetration of moisture through the external protective material (seal or encapsulant) or along the package interface and the metallic conductors. The test accelerates the corrosion of the metal parts of the product, including the metallization on the surface of the die.

REFERENCE STANDARDS:

The test was conducted according to JEDEC standard JESD-A110-B (Highly-Accelerated Temperature and Humidity Stress Test)

RESULT:

No functional failures were observed after stress. No anomaly was found on the package after stressing upon acoustic microscopy inspection. Therefore, device passed Biased Corrosion Test.

TEST SEQUENCE	CONTROL LOT (Rej/SS)	QUAL LOT A (Rej/SS)	QUAL LOT B (Rej/SS)	QUAL LOT C (Rej/SS)
MOISTURE RESISTANCE TEST	0/77	0/77	0/77	0/77
ACOUSTIC MICROSCOPY INSPECTION	0/25[1]	0/25	0/25	0/25
FUNCTIONAL TEST AT 125^{O}C	0/77	0/77	0/77	0/77
BIASED-HAST, 130^{O}C/85% RH FOR 96 HOURS	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT 125^{O}C	0/77	0/77	0/77	0/77

[1]With Die Pad delamination was observed, however the part has no provision for down/ground bond.

6.1.5 HIGH TEMPERATURE OPERATING LIFE TEST

PURPOSE:

This test is performed to determine the reliability of devices under operation at high temperature conditions over an extended period of time.

REFERENCE STANDARDS:

The test was conducted according to JEDEC standard JESD22-A108-C (Temperature, Bias and Operating Life).

RESULT:

No functional failures were observed after stress. Device passed High Temperature Operating Life Test.

TEST SEQUENCE	CONTROL LOT (Rej/SS)	QUAL LOT A (Rej/SS)	QUAL LOT B (Rej/SS)	QUAL LOT C (Rej/SS)
FUNCTIONAL TEST AT 125^{O}C	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT - 40^{O}C	0/77	0/77	0/77	0/77
HIGH TEMPERATURE OPERATING LIFE TEST AT 125^{O}C FOR 1000H	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT 125^{O}C	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT - 40^{O}C	0/77	0/77	0/77	0/77

6.1.6 HIGH TEMPERATURE STORAGE TEST

PURPOSE:

The high temperature storage stress evaluates the package off-chip interconnects. Two typical failures found during this test, they are:

1.) Ionic contamination of the metallization due to the additives in the molding compound (e.i. flame retardant); this often referred as die corrosion.

2.) Degradation of the Au ball on the Al pads.

REFERENCE STANDARD:

The test was run according to JEDEC standard JESD-103.

RESULT:

No function failures were observed after 500 and 1000 hours high temperature storage test. Therefore, package passed High Temperature Storage Life test.

TEST SEQUENCE	CONTROL LOT (Rej/SS)	QUAL LOT A (Rej/SS)	QUAL LOT B (Rej/SS)	QUAL LOT C (Rej/SS)
FUNCTIONAL TEST AT 125^{O}C	0/77	0/77	0/77	0/77
HIGH TEMPERATURE STORAGE TEST, 150 ^{O}C FOR 500H	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT 125^{O}C	0/77	0/77	0/77	0/77
HIGH TEMPERATURE STORAGE TEST, 150 ^{O}C FOR 1000H	0/77	0/77	0/77	0/77
FUNCTIONAL TEST AT 125^{O}C	0/77	0/77	0/77	0/77

6.1.7 INTERNAL INSPECTION

PURPOSE:

The internal contact tests are done to verify the workmanship of the assembly process before molding (front-end of the assembly process). X-ray and acoustic microscopy (non-destructive tests) were performed first followed by decapsulation, internal visual inspection, and the destructive tests, such as bond pull & bond shear test.

REFERENCE STANDARDS:

AEC-Q100-001 (Bond Shear Test)
Jedec spec J-STD-020 (Scanning Acoustic Microscopy)
Mil-Std-883 Method 2001 (Bond Pull Strength)
Mil-Std-883 Method 2010 (Internal Visual)
Mil-Std-883 Method 2012 (X-ray)

RESULT:

No workmanship problems were detected during the internal contact tests of the LQFP package. All test results are passing the qualification requirements.

TEST SEQUENCE	CONTROL LOT (Rej/SS)	QUAL LOT A (Rej/SS)	QUAL LOT B (Rej/SS)	QUAL LOT C (Rej/SS)
X-RAY INSPECTION	0/15	0/15	0/15	0/15
PHYSICAL DIMENSIONS INSPECTION	0/10	0/10	0/10	0/10
INTERNAL VISUAL	0/5	0/5	0/5	0/5
BOND PULL TEST[1,3]	0/5	0/5	0/5	0/5
BOND SHEAR TEST[2,3]	0/5	0/5	0/5	0/5

[1]Bond pull test was done on 30 wires from 5 parts with 3.0 grams minimum reading as passing criterion and Cpk>1.33.
[2]Bond shear test was done on 30 ball bonds from 5 parts with 13 grams minimum reading as passing criterion and Cpk>1.33.
[3]Assy generic data was used for bond shear and bond pull tests.

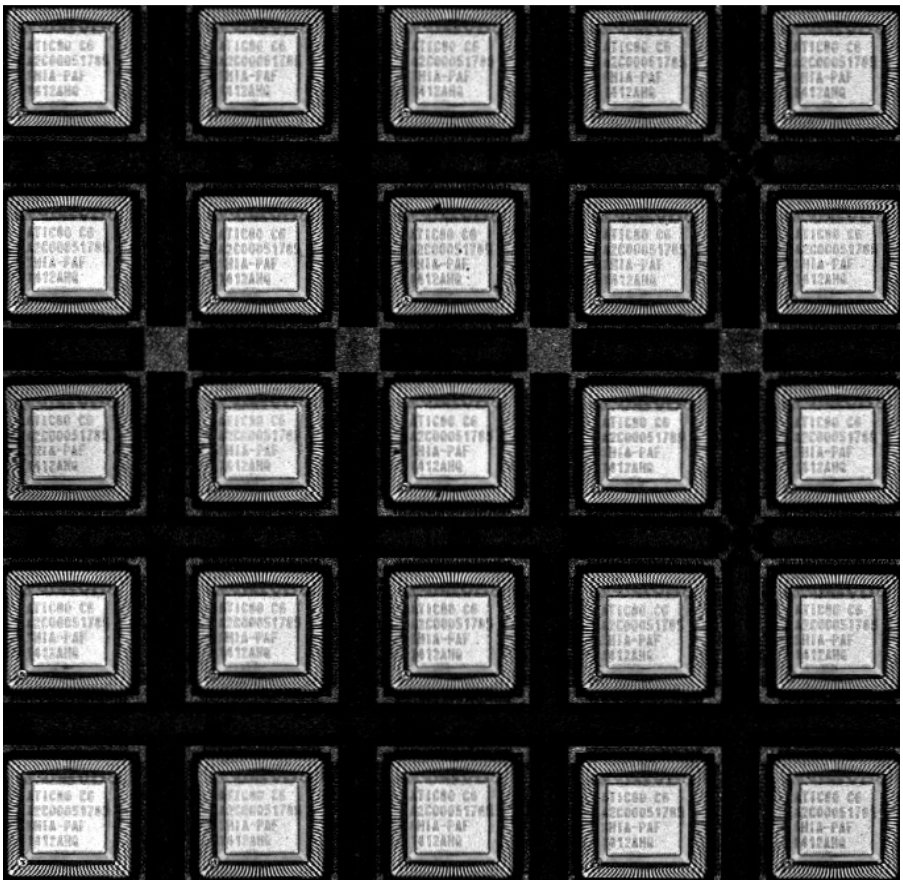


Figure 10: Acoustic Microscopy images of fresh units. No package anomaly was observed.

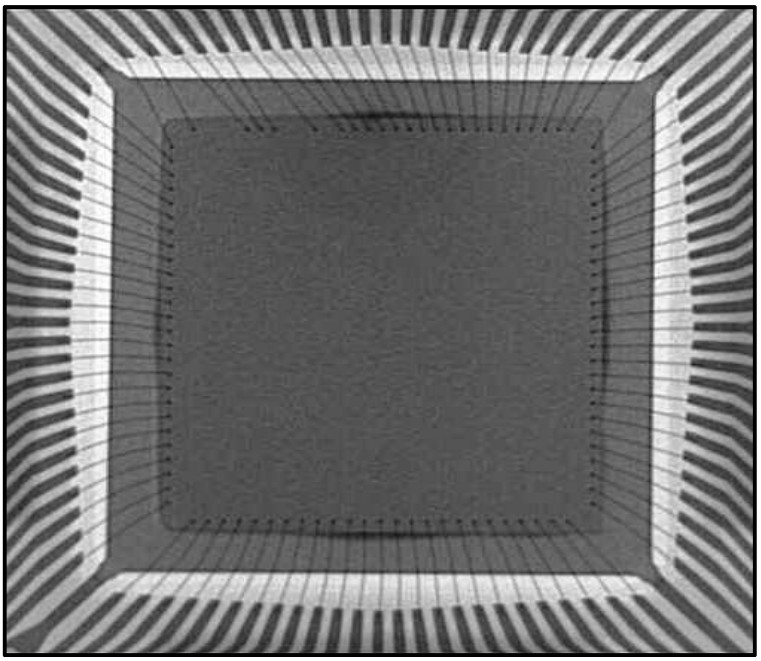


Figure 11: X-ray image of the LQFP package.

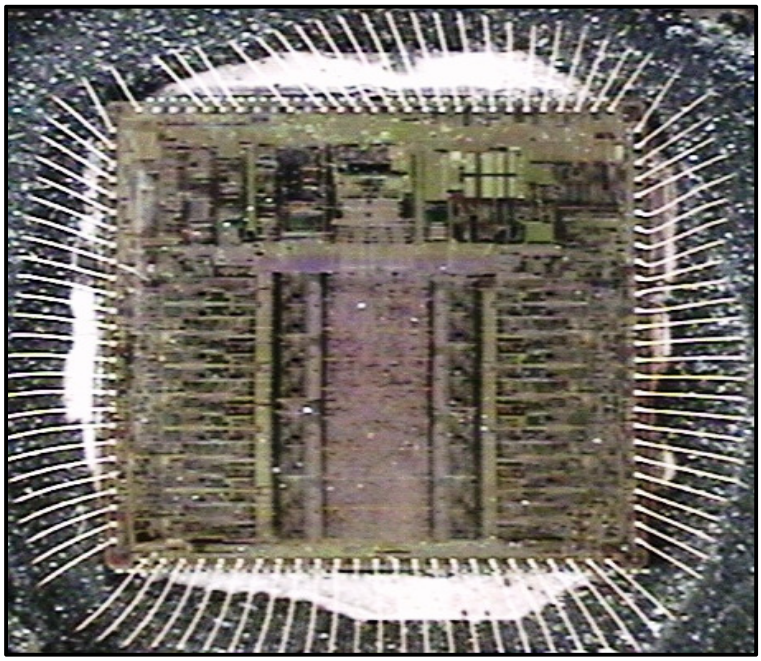


Figure 12: Die photo of LQFP package.

Process	Test Item	Criteria	Reject/ S.S.	Test Data					Result
				MAX	MIN	AVG	STDEV	Cpk	
Die Bond	Die Shear	min 2.5	2 units	1.58	1.54	1.56	0.02	N/A	Pass
Die Bond	Adhesive Void	Max. 20%	5 units	0.00	0.00	0.00	0.00	N/A	Pass
Die Bond	Die Tilt(Wet)	1% of die size	5 units	0.30	0.30	0.30	0.00	N/A	Pass
Die Bond	Adhesive Thickness	Min 0.6mil	5 units	1.20	0.90	1.06	0.11	N/A	Pass
Die Bond	Visual Inspection	001-2005	116 units	0/116					Pass
Wire Bond	Loop Height	Max 21mil	10 wires	6.60	6.40	6.48	0.07	N/A	Pass
Wire Bond	Wire Pull	Min 3gf	45 wires	9.93	7.35	9.21	0.52	3.95	Pass
Wire Bond	Ball Shear	Min 13	45 balls	35.83	27.89	31.36	2.11	2.90	Pass
Mold	Visual Inspection	01-2476	100%	0/1464					Pass
Mold	SAT inspection	01-3479	22 units	0/22Units					Pass
Mold	X-Ray inspection	01-2223	100%	0/1464					Pass
Mold	Internal void	01-2223	30 units	0/30Units					Pass
Trim	Visual Inspection	001-2011	45 units	0/45					Pass
Laser Mark	Visual Inspection	001-2011	116 units	0/116					Pass
Plate	Visual Inspection	001-2011	100 units	0/116					Pass
Plate	Solderabiliry test	001-2011	10 units	0/5					Pass
Plate	Tin thickness	400~700um	10 points	498.00	443.00	476.40	17.00	N/A	Pass
Form/Singulation	Micro Gap/Crack	Any Rej.	20 units	0/20					Pass
Form/Singulation	Coplanarity	Max. 3mil	10 units	0.48	0.23	0.35	0.08	N/A	Pass
Form/Singulation	Foot Angle	0~7 Degree	10 units	2.70	2.30	2.51	0.14	N/A	Pass
Form/Singulation	Foot Length	0.45~0.75mm	10 units	0.59	0.54	0.57	0.01	N/A	Pass
Form/Singulation	Tip To Tip (X)	16+/-0.2mm	10 units	16.00	15.99	16.00	0.01	N/A	Pass
Form/Singulation	Tip To Tip (Y)	16+/-0.2mm	10 units	16.00	15.99	16.00	0.01	N/A	Pass
Form/Singulation	S.O.H	2~6mils	10 units	4.20	3.80	4.01	0.12	N/A	Pass
FVI	Visual Inspection	001-2011	100%	0/100%					Pass

Figure 13: Assy generic data of **Qual Lot A** for Bond Pull and Bond Shear tests w/ passing results.

Process	Test Item	Criteria	Reject/ S.S.	Test Data					Result
				MAX	MIN	AVG	STDEV	Cpk	
Die Bond	Die Shear	min 2.5	2 units	38.72	29.36	34.04	6.62	N/A	Pass
Die Bond	Adhesive Void	Max. 20%	5 units	0.00	0.00	0.00	0.00	N/A	Pass
Die Bond	Die Tilt(Wet)	1% of die size	5 units	0.30	0.30	0.30	0.00	N/A	Pass
Die Bond	Adhesive Thickness	Min 0.6mil	5 units	1.20	0.90	1.04	0.11	N/A	Pass
Die Bond	Visual Inspection	001-2005	116 units	0/116					Pass
Wire Bond	Loop Height	Max 21mil	10 wires	12.40	5.70	9.04	3.41	N/A	Pass
Wire Bond	Wire Pull	Min 3gf	45 wires	10.32	8.31	9.36	0.49	4.31	Pass
Wire Bond	Ball Shear	Min 13	45 balls	36.76	28.52	32.84	2.50	2.65	Pass
Mold	Visual Inspection	01-2476	100%	0/625					Pass
Mold	SAT inspection	01-3479	22 units	0/22Units					Pass
Mold	X-Ray inspection	01-2223	100%	0/625					Pass
Mold	Internal void	01-2223	30 units	0/30Units					Pass
Trim	Visual Inspection	001-2011	45 units	0/45					Pass
Laser Mark	Visual Inspection	001-2011	116 units	0/116					Pass
Plate	Visual Inspection	001-2011	100 units	0/116					Pass
Plate	Solderabiliry test	001-2011	10 units	0/5					Pass
Plate	Tin thickness	400~700um	10 points	492.00	443.00	467.40	14.52	N/A	Pass
Form/Singulation	Micro Gap/Crack	Any Rej.	20 units	0/20					Pass
Form/Singulation	Coplanarity	Max. 3mil	10 units	0.32	0.21	0.25	0.04	N/A	Pass
Form/Singulation	Foot Angle	0~7 Degree	10 units	3.50	2.50	2.83	0.35	N/A	Pass
Form/Singulation	Foot Length	0.45~0.75mm	10 units	0.58	0.54	0.56	0.01	N/A	Pass
Form/Singulation	Tip To Tip (X)	16+/-0.2mm	10 units	16.00	15.99	16.00	0.01	N/A	Pass
Form/Singulation	Tip To Tip (Y)	16+/-0.2mm	10 units	16.00	15.99	16.00	0.01	N/A	Pass
Form/Singulation	S.O.H	2~6mils	10 units	3.60	3.40	3.52	0.06	N/A	Pass
FVI	Visual Inspection	001-2011	100%	0/100%					Pass

Figure 14: Assy generic data of **Qual Lot B** for Bond Pull and Bond Shear tests w/ passing results.

Process	Test Item	Criteria	Reject/ S.S.	Test Data					
				MAX	MIN	AVG	STDEV	Cpk	Result
Die Bond	Die Shear	min 2.5	2 units	43.22	35.52	39.37	5.44	N/A	Pass
Die Bond	Adhesive Void	Max. 20%	5 units	0.00	0.00	0.00	0.00	N/A	Pass
Die Bond	Die Tilt(Wet)	1% of die size	5 units	0.30	0.30	0.30	0.00	N/A	Pass
Die Bond	Adhesive Thickness	Min 0.6mil	5 units	1.20	0.90	1.04	0.11	N/A	Pass
Die Bond	Visual Inspection	001-2005	116 units	0/116					Pass
Wire Bond	Loop Height	Max 21mil	10 wires	12.40	5.70	9.00	3.45	N/A	Pass
Wire Bond	Wire Pull	Min 3gf	45 wires	10.78	8.04	9.17	0.58	3.56	Pass
Wire Bond	Ball Shear	Min 13	45 balls	37.73	30.56	34.79	1.60	4.53	Pass
Mold	Visual Inspection	01-2476	100%	0/629					Pass
Mold	SAT inspection	01-3479	22 units	0/22Units					Pass
Mold	X-Ray inspection	01-2223	100%	0/629					Pass
Mold	Internal void	01-2223	30 units	0/30Units					Pass
Trim	Visual Inspection	001-2011	45 units	0/45					Pass
Laser Mark	Visual Inspection	001-2011	116 units	0/116					Pass
Plate	Visual Inspection	001-2011	100 units	0/116					Pass
Plate	Solderabiliry test	001-2011	10 units	0/5					Pass
Plate	Tin thickness	400~700um	10 points	550.00	488.00	503.30	19.95	N/A	Pass
Form/Singulation	Micro Gap/Crack	Any Rej.	20 units	0/20					Pass
Form/Singulation	Coplanarity	Max. 3mil	10 units	0.44	0.22	0.28	0.06	N/A	Pass
Form/Singulation	Foot Angle	0~7 Degree	10 units	3.00	2.30	2.62	0.23	N/A	Pass
Form/Singulation	Foot Length	0.45~0.75mm	10 units	0.58	0.54	0.56	0.01	N/A	Pass
Form/Singulation	Tip To Tip (X)	16+/-0.2mm	10 units	16.00	16.00	16.00	0.01	N/A	Pass
Form/Singulation	Tip To Tip (Y)	16+/-0.2mm	10 units	16.00	15.99	16.00	0.01	N/A	Pass
Form/Singulation	S.O.H	2~6mils	10 units	4.20	4.00	4.10	0.08	N/A	Pass
FVI	Visual Inspection	001-2011	100%	0/100%					Pass

Figure 15: Assy generic data of **Qual Lot C** for Bond Pull and Bond Shear tests w/ passing results.

6.1.8 EXTERNAL INSPECTION

PURPOSE:

The external workmanship tests are done to verify external quality and workmanship of the back-end of the assembly process.

REFERENCE STANDARDS:

Mil-Std-883 Method 2009 (External Visual)

RESULT:

No workmanship problems were observed during the external tests of LQFP package. All samples passed external visual inspection.

TEST SEQUENCE	SAMPLE SIZE	FAILURES OBSERVED	FAILURES ALLOWED	JUDGMENT
EXTERNAL VISUAL	ALL	0	0	PASSED

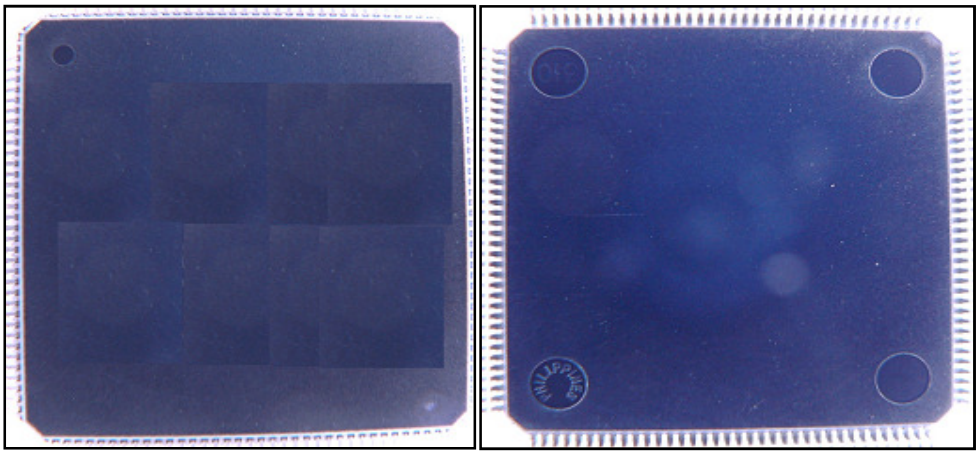


Figure 16: Top (left-side) and bottom (right-side) view of the LQFP package.