Destructive Physical Analysis

Job Number: 2203332

Customer:
Date: 4/29/2022
P.O. Number:
Reference Number:
Manufacturer:
Part Type: Microcircuit, plastic
Part Number:
Date Code: unknown
Quantity: 3

Lot Disposition: Does Not Meet Requirements

Submitted By: Marilyn Urness

Reviewed By: Sam Kenyon

Approved By: Jared Finney

Test Summary

Testing performed in accordance with: MIL-STD-1580C Requirement 16.5

Task Description	Requirements	Qty.	Disposition	Comments
External Visual Inspection	Para. 16.5.1.1	3	Acceptable	
Prohibited Materials Analysis of the External Surfaces	Requirement 9	1	Acceptable	
Radiographic Examination	Para. 16.5.1.2	3	Acceptable	
Acoustic Microscopy	Para. 16.5.1.3	3	Acceptable	
Internal Visual Inspection (Depot)	Para. 16.5.1.6	2	Acceptable	
Internal Visual Inspection (Cross Section)	Para. 16.5.1.6	1	Customer Review	S/N 3: Dye penetration into package.
Bond Pull	Para. 16.5.1.8	2	Acceptable	
Wire Bond Ball Shear Test	Para. 16.5.1.7	2	Acceptable	
Prohibited Materials Analysis of the Internal Surfaces	Requirement 9		Not Required	
Glassivation Layer Integrity	Para. 16.5.1.9 and 16.5.1.6.1.b	1	Acceptable	
Metallization Examination (SEM)	Para. 16.5.1.10	2	Rejectable	S/N 1, 2: Thinning Metal 1, Metal 2. Rejectable per MIL-STD-883, Method 2018, Para. 3.7.2.

Test Summary

Testing performed in accordance with: MIL-STD-1580C Requirement 16.5

Task Description	Requirements	Qty.	Disposition	Comments
Cross Section for Thinning Metallization	Para. 16.5.1.10.a	1	Rejectable	Cross section of S/N 3 revealed Rejectable thinning metal.

Hi-Rel Laboratories, Inc.

Certificate of Conformance

Job Number: 2203332	Date: 4/29/2022
Description: Microcircuit, plastic	Customer:
Part Number:	Address:
Manufacturer:	P.O. Number:
Lot Date Code: unknown	Lot Number:
Quantity: 3	Customer Reference:
Sample/Serial Numbers: 1, 2, 3	
Specification: MIL-STD-1580C Requirement 16.5 and applicable military standards.	

Lot Disposition: Does Not Meet Requirements

Trevor Devaney
Quality Assurance

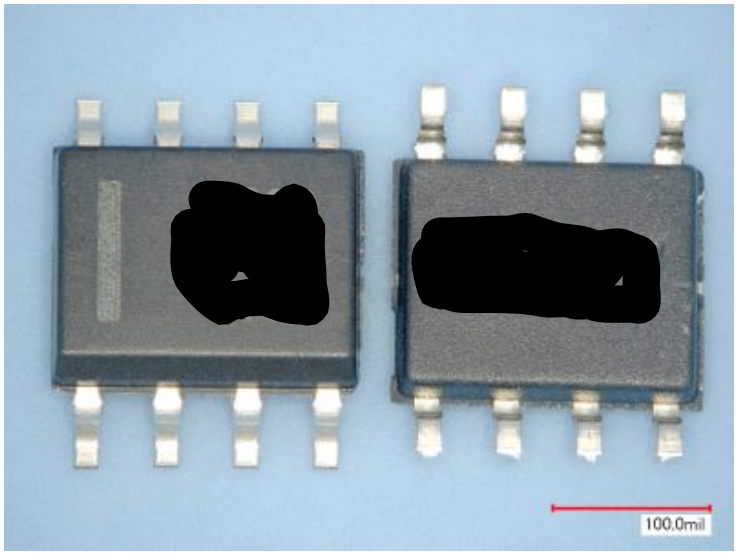
6116 NORTH FREYA • SPOKANE • WASHINGTON 99217 • (509) 325-5800 • FAX (509) 325-9508 • www.hrlabs.com

External Visual Inspection

Disposition: Acceptable

Performed per: MIL-STD-1580C

Sample Number				
1	2	3		
A	A	A		



Anomalies

A. No Anomalies

B. Foreign Material
1. On lead(s)
2. On package
3.

C. Package Condition
1. Crazed or bubbled surface
2. Corrosion
3. Mechanically damaged
4. Void(s)
5.

D. Markings
1. Illegible
2. Non-conformant to paperwork
3. Varies part to part
4.

E. Other
1.
2.

X. Induced during handling
Y. Induced during testing
Z. Induced at IGA

* Meets Acceptance Criteria
**
Δ Customer Review

Kendra Skrapits
Inspector

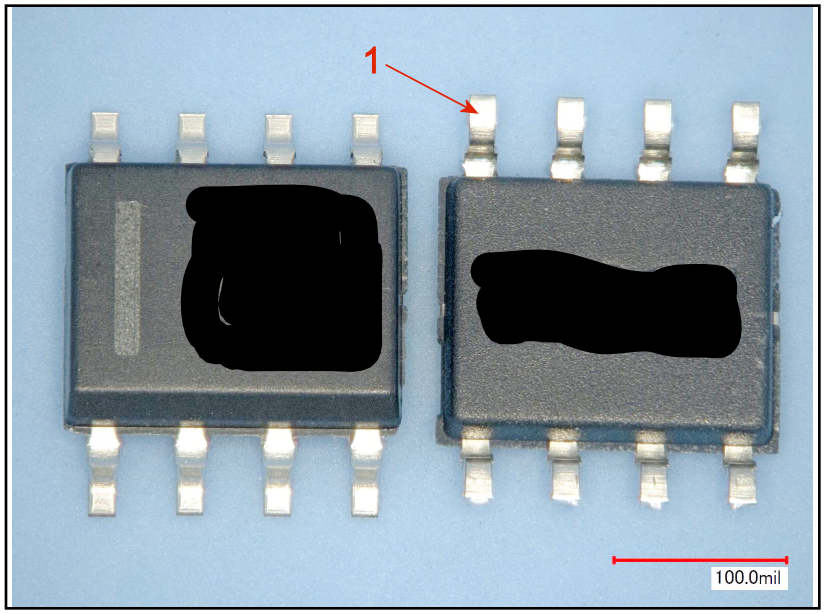
3/28/2022
Date

Form 101 Rev C

Prohibited Materials Analysis- External

Disposition: Acceptable

Performed per: MIL-STD-1580C REQ. 9



Numbers correspond to representative locations.

Sample 1		
Location	**Description**	**Composition**
1	Lead Finish	Ni/Pd/Au

Test Parameters:
Beam Votage: 20 kV Working Distance: 17 mm Take-off Angle: 35° Dead Time: < 40%

Shaye Fetzer
Inspector

3/28/2022
Date

Radiographic Inspection

Disposition: Acceptable

Performed per: PARA. 16.5.1.2

Sample Number				
1	2	3		
A	A	A		

Anomalies

A. No Anomalies

B. Attaches
1. Excessive die attach
2. Inadequate die attach
3. Contact area voids
4.

C. Alignment
1. Misaligned element(s)
2. Lid misaligned to package
3. Misaligned leads
4.

D. Foreign Material
1. Bridging
2. In seal
3. In cavity area
4.
5.

E. Internal Lead Wires
1. Broken wire(s)
2. Excess stress relief (loop or sag)
3. Excess wire tail
4. Improperly placed bond
5. Improper or incomplete weld
6. Inadequate stress relief (straight line run)
7. Loose or lifted bond
8.

F. Seal(s)
1. Excess seal material
2. Inadequate seal material
3. Void(s)
4.

X. Induced during handling
Y. Induced during testing
Z. Induced at IGA

* Meets Acceptance Criteria
**

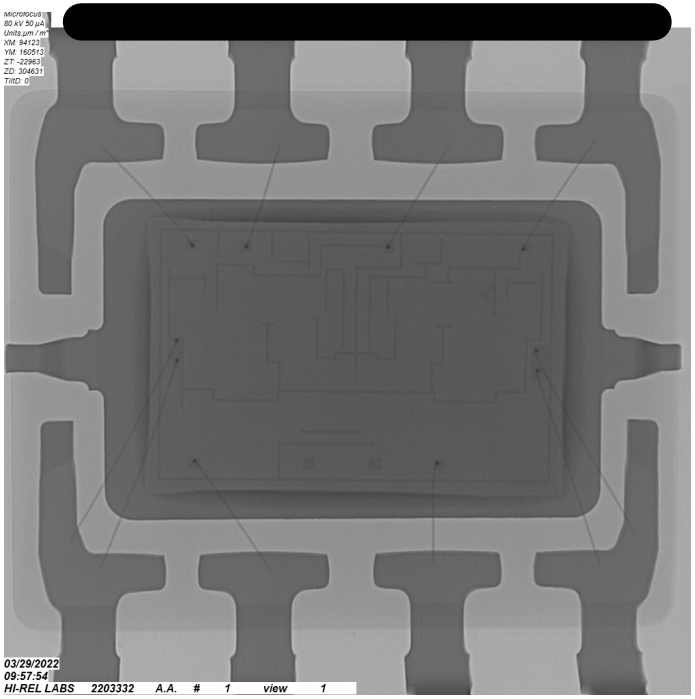
Δ Customer Review

Adric Allen
Inspector

3/29/2022
Date

Sample Number

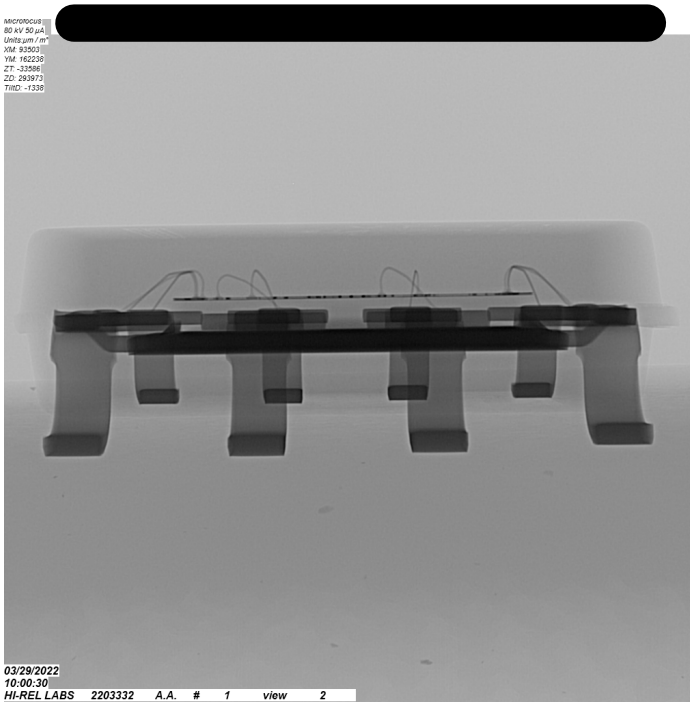
1



Radiographic image, view 1.

Sample Number

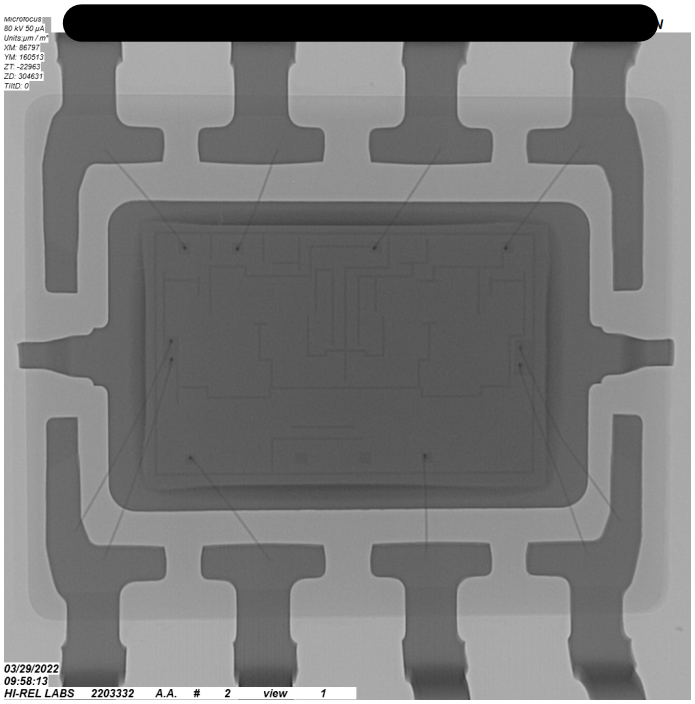
1



Radiographic image, view 2.

Sample Number

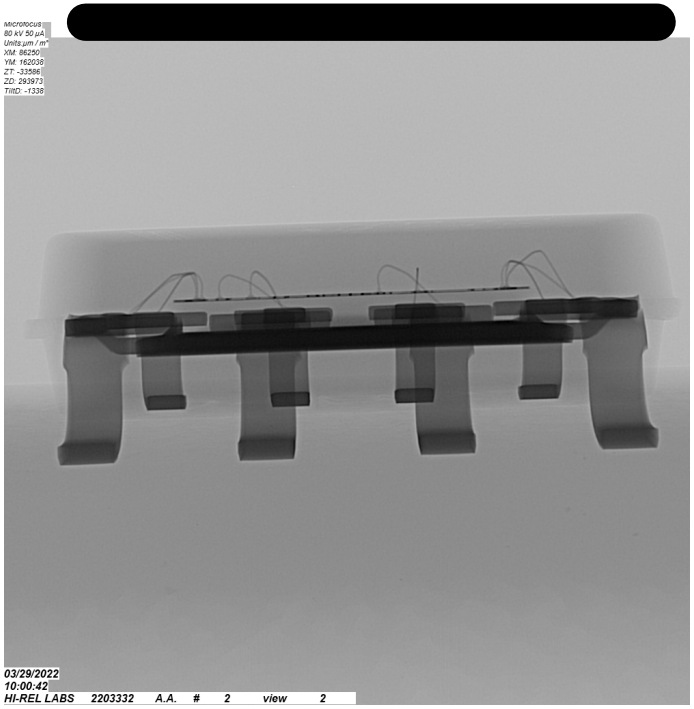
2



Radiographic image, view 1.

Sample Number

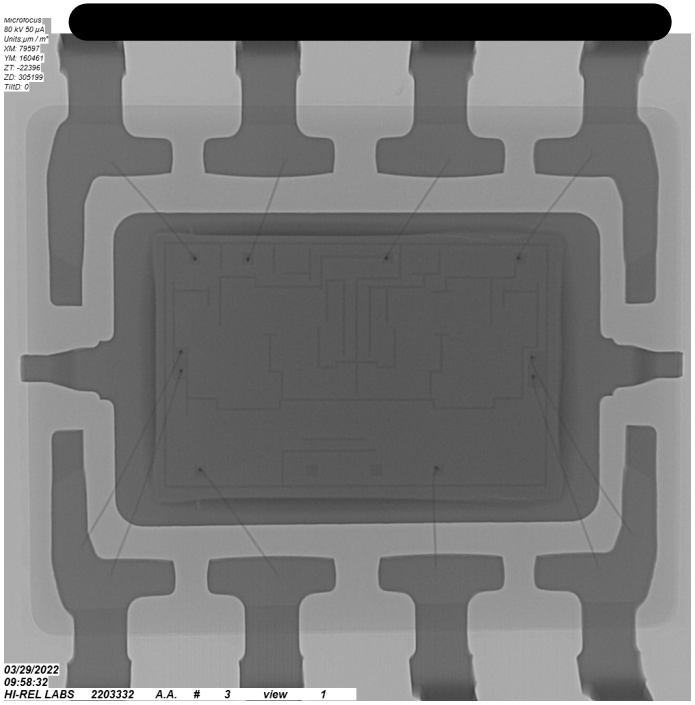
2



Radiographic image, view 2.

Sample Number

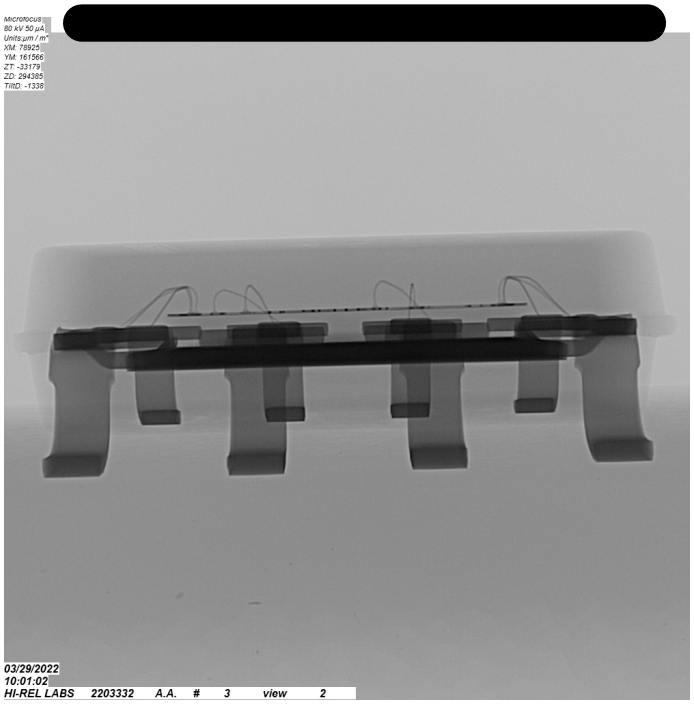
3



Radiographic image, view 1.

Sample Number

3



Radiographic image, view 2.

Acoustic Microscopy

Disposition: Acceptable

Performed per: MIL-STD-1580 REV C PARA 16.5.1.3

Location	View	Sample Number					
		1	2	3			
DIE/ LEAD FRAME/ PADDLE (CIRCUIT SIDE)	1	A	A	A			
PADDLE/ LEAD FRAME (NON CIRCUIT SIDE)	2	A	A	A			

Anomalies	Location
A. No Anomalies	1.
B. Crack	2.
C. Void	3.
D. Delamination	4.
E.	5.

Comments:

* Meets Acceptance Criteria

**

Δ Customer Review

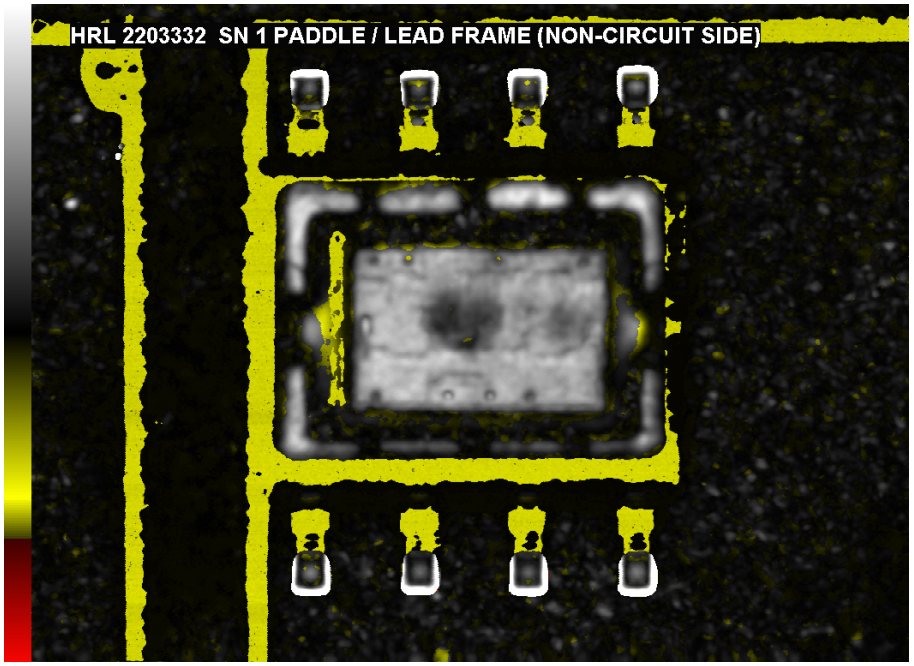
Adam Benak
Inspector

3/30/2022
Date

Form 161 Rev C E# 156

Sample Number

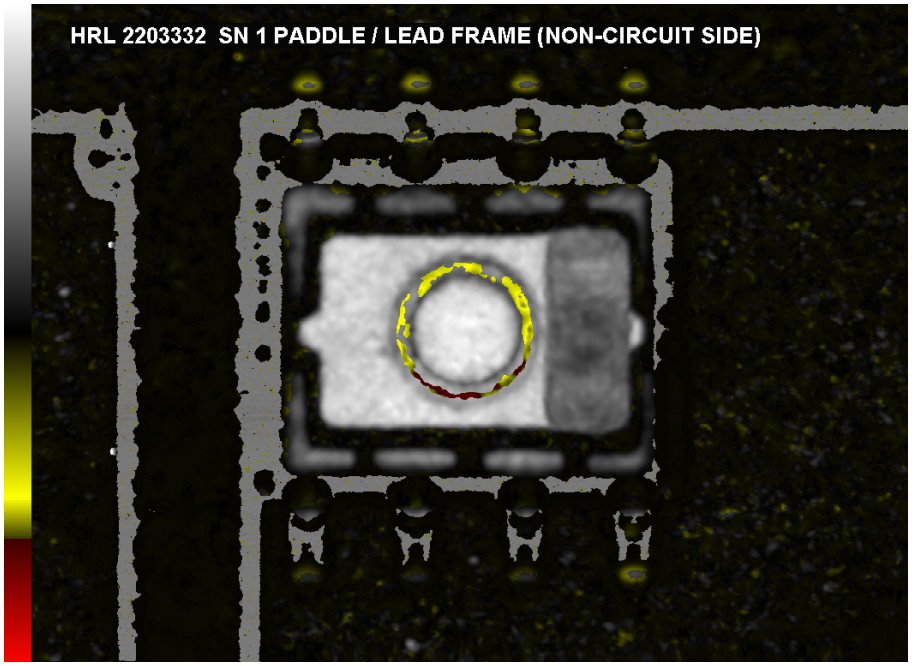
1



SAM image, view 1.

Sample Number

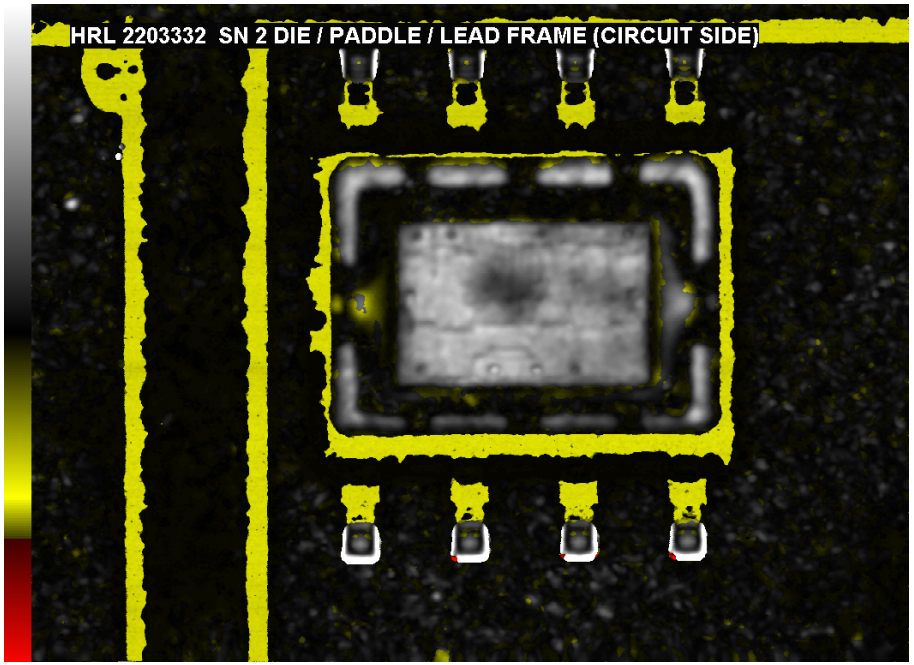
1



SAM image, view 2.

Sample Number

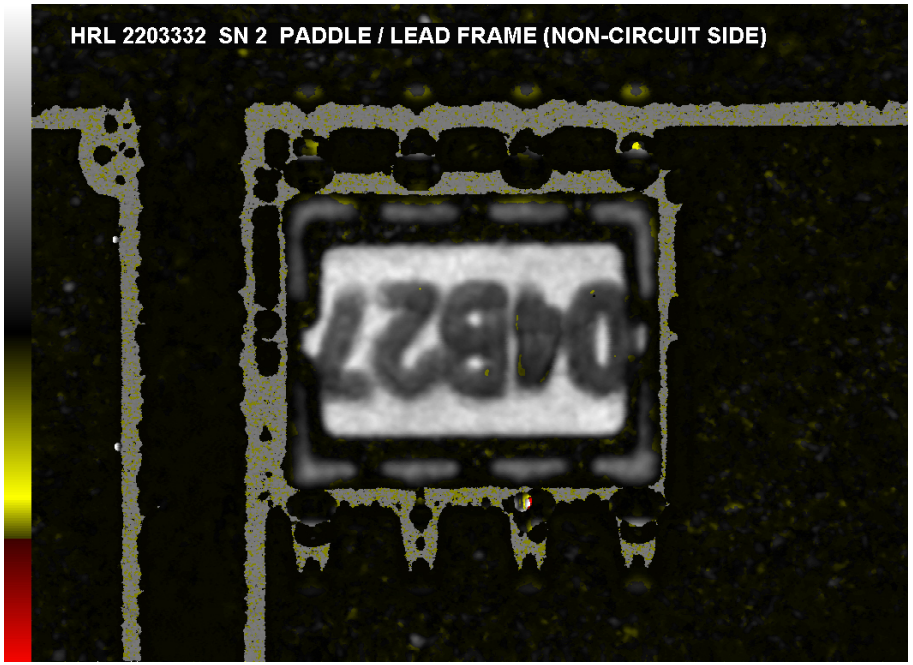
2



SAM image, view 1.

Sample Number

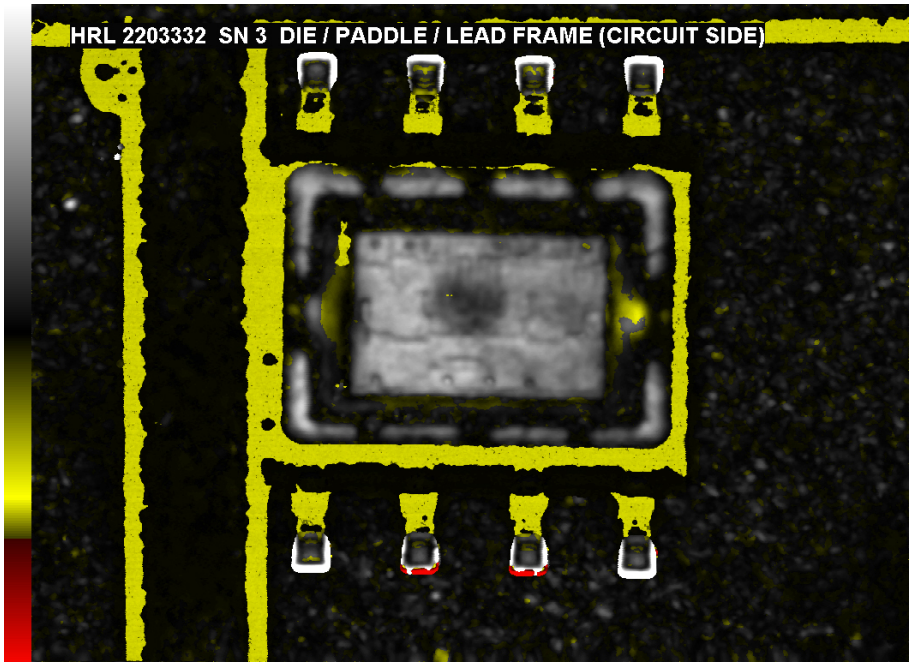
2



SAM image, view 2.

Sample Number

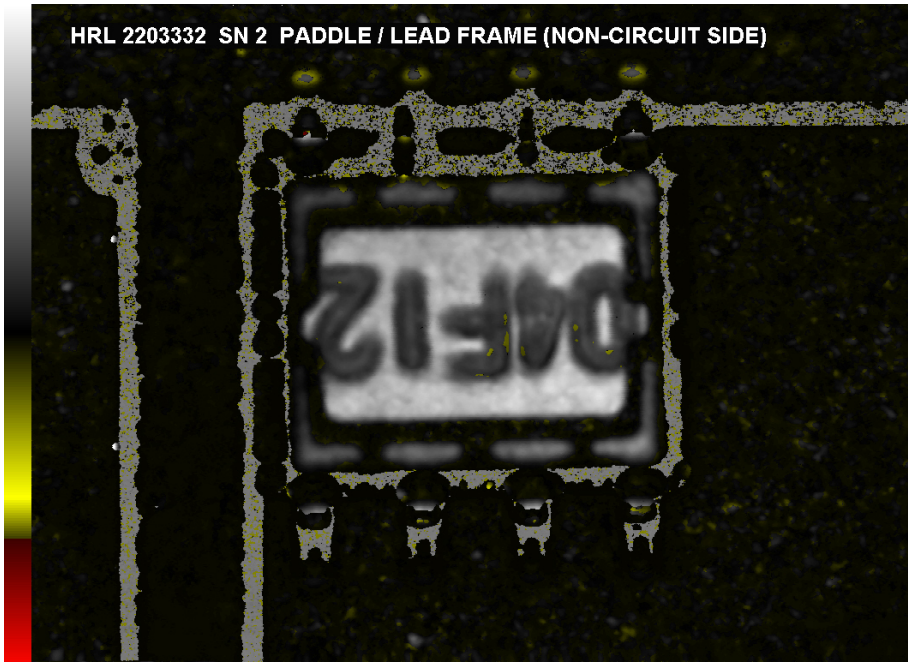
3



SAM image, view 1.

Sample Number

3



SAM image, view 2.

Internal Visual Inspection - Microcircuit

Disposition: Acceptable

Performed per: PARA. 16.5.1.6

Sample Number				DEPOT
1-2				
E3 Y				
C1 *				

Anomalies

A. No Anomalies

B. Bonds
1. Encapsulated in seal material
2. Misaligned to pad
3. Over entering/exiting metallization
4. Placed on attach or foreign material
5.

C. Die Defects
1. Chipout(s)
2. Crack(s) pointing towards or in active area
3. Diffusion anomaly
4. Glassivation crack(s)
5. Glassivation void(s)
6. Metallization bridging
7. Metallization corrosion
8. Metallization peeling
9. Multiple lines or complete absence of passivation continuing under metallization
10. Oxide void(s)
11. Shooting metallization
12. Scratch
13.

D. Die Mounting Defects
1. Attach material extending onto die surface
2. Inadequate bonding material around die perimeter
3. Void(s) in attach material
4.

E. Foreign Material
1. Attached
2. Chemical processing material
3. On surface
4.

F. Wire Defects
1. Bent wire(s)
2. Broken wire(s)
3. Crossing wires
4. Excess wire loop height
5. Straight line run (no stress relief)
6. Low wire clearance
7.

G. Other
1. Dye penetration into package
2.
3.

X. Induced during handling
Y. Induced during testing
Z. Induced at IGA

* Meets Acceptance Criteria
**

Δ Customer Review

William Collins 4/12/2022

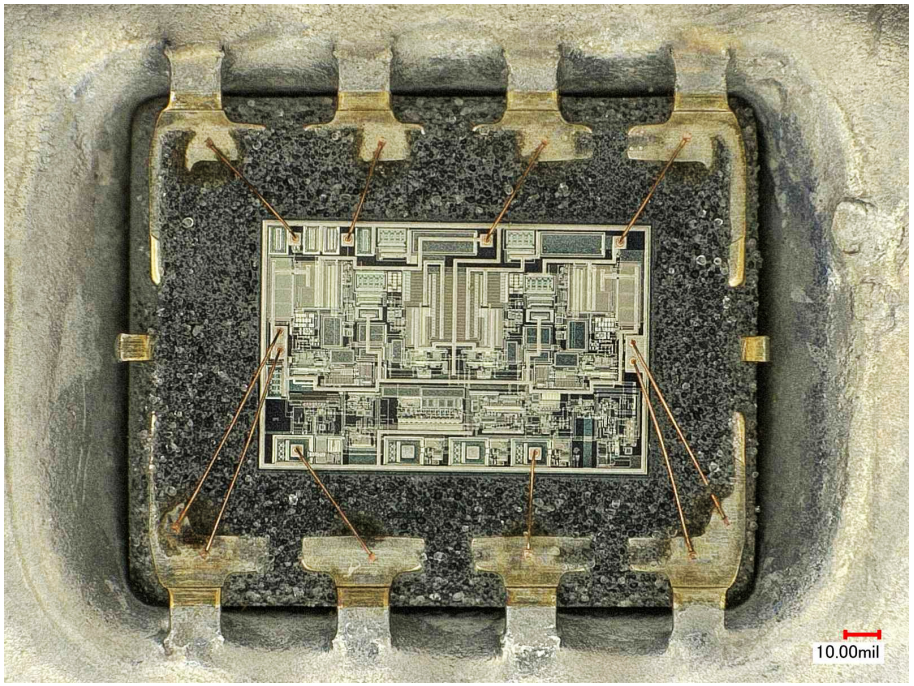
Bill Collins
Inspector

Date

Form 118 Rev B

Sample Number

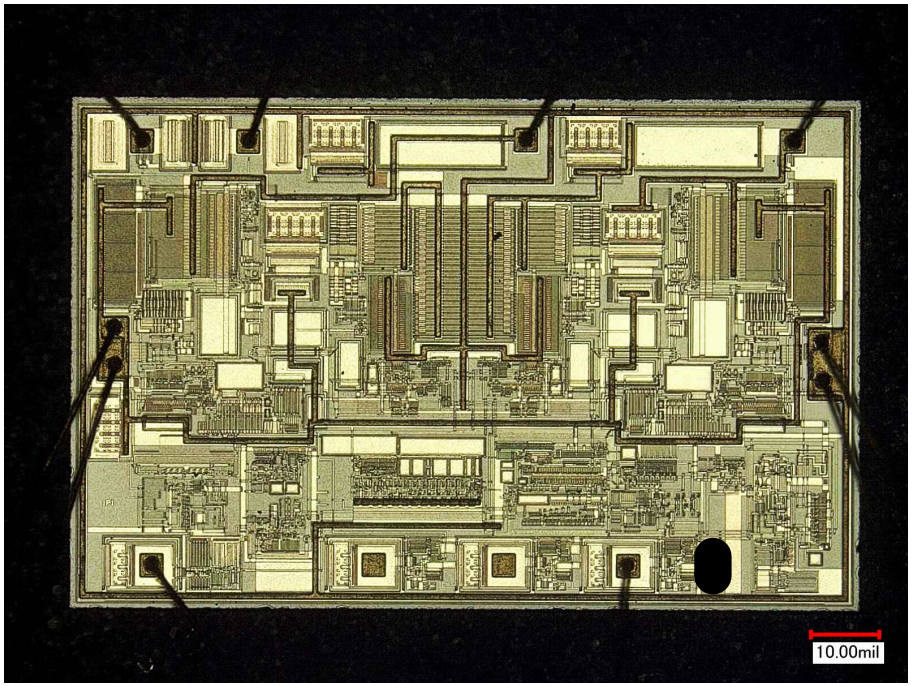
1



Overall view of depotted device.

Sample Number

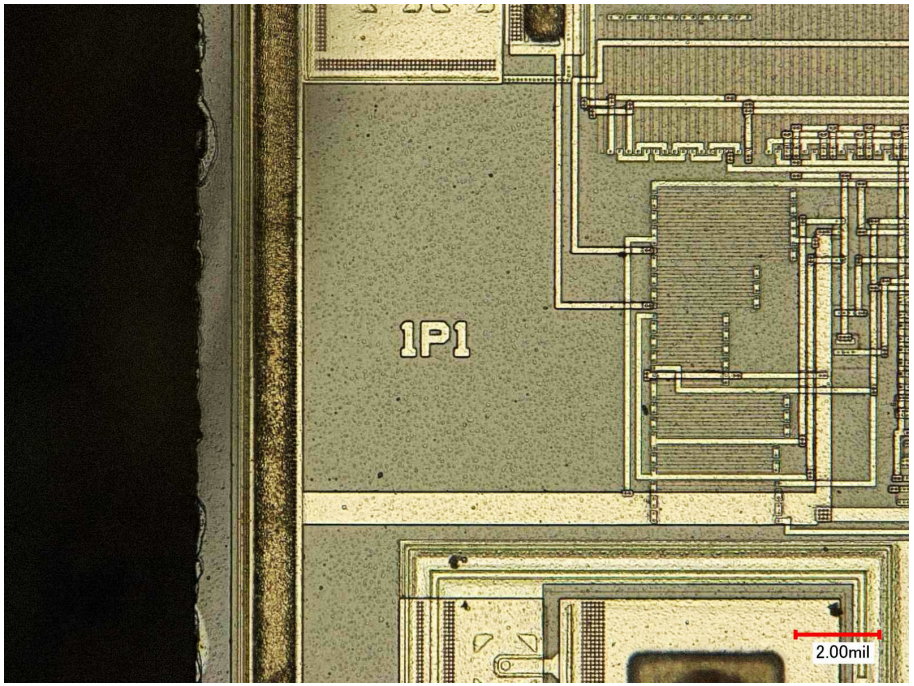
1



Overall view of die.

Sample Number

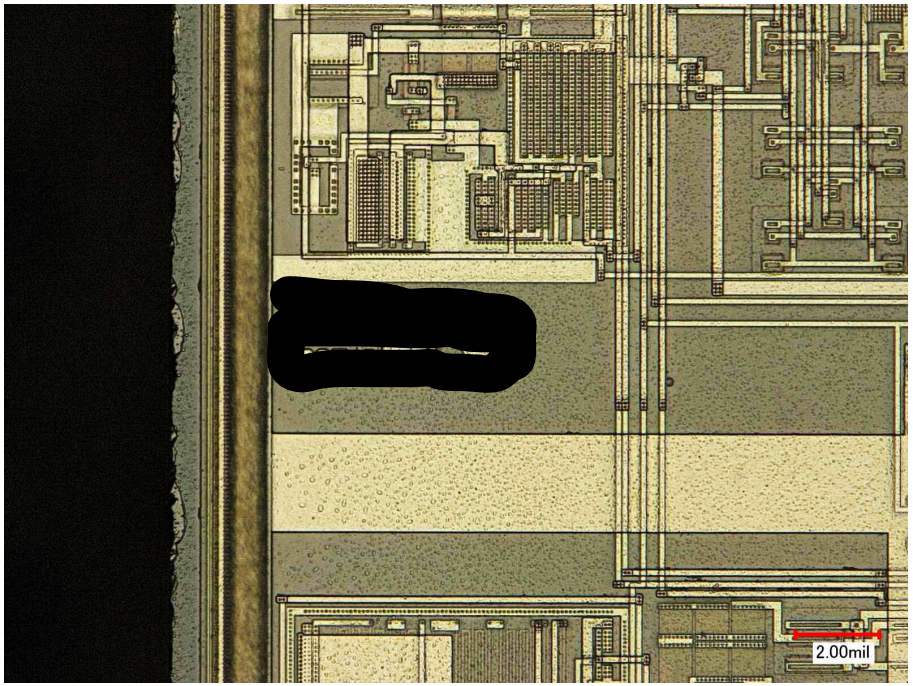
1



Detailed view of die.

Sample Number

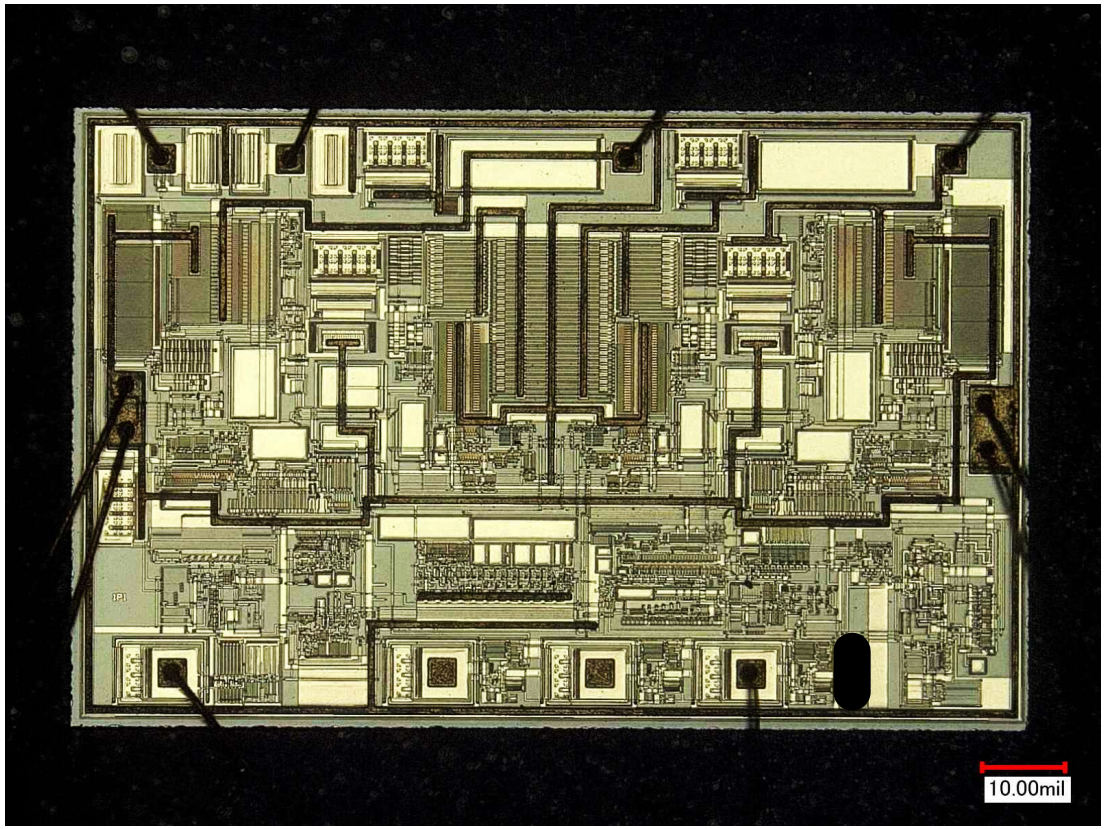
1



Detailed view of die.

Sample Number

2



Overall view of die.

Internal Visual Inspection - Microcircuit

Disposition: Customer Review

Performed per: PARA. 16.5.1.6

Sample Number				Sectioned
3				
C13 Y				
G1 Δ				

Anomalies

A. No Anomalies

B. Bonds
1. Encapsulated in seal material
2. Misaligned to pad
3. Over entering/exiting metallization
4. Placed on attach or foreign material
5.

C. Die Defects
1. Chipout(s)
2. Crack(s) pointing towards or in active area
3. Diffusion anomaly
4. Glassivation crack(s)
5. Glassivation void(s)
6. Metallization bridging
7. Metallization corrosion
8. Metallization peeling
9. Multiple lines or complete absence of passivation continuing under metallization
10. Oxide void(s)
11. Shooting metallization
12. Scratch
13. Crack(s) in die

D. Die Mounting Defects
1. Attach material extending onto die surface
2. Inadequate bonding material around die perimeter
3. Void(s) in attach material
4.

E. Foreign Material
1. Attached
2. Chemical processing material
3. On surface
4.

F. Wire Defects
1. Bent wire(s)
2. Broken wire(s)
3. Crossing wires
4. Excess wire loop height
5. Straight line run (no stress relief)
6. Low wire clearance
7.

G. Other
1. Dye penetration into package
2.
3.

X. Induced during handling
Y. Induced during testing
Z. Induced at IGA

* Meets Acceptance Criteria
**

Δ Customer Review

Form 118 Rev B

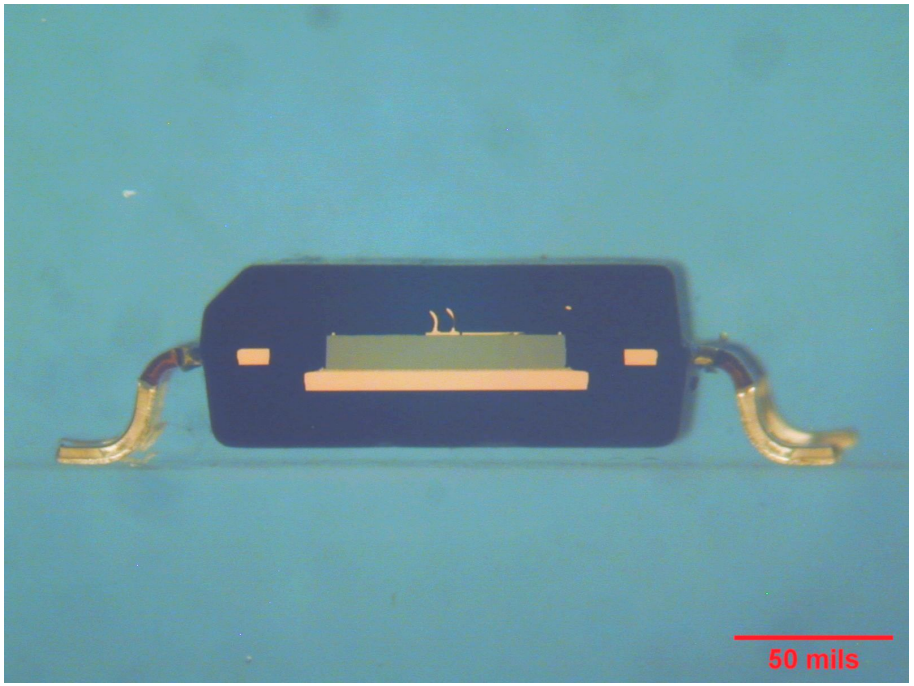
4/28/2022

Kenneth David Jarrett
Inspector

Date

Sample Number

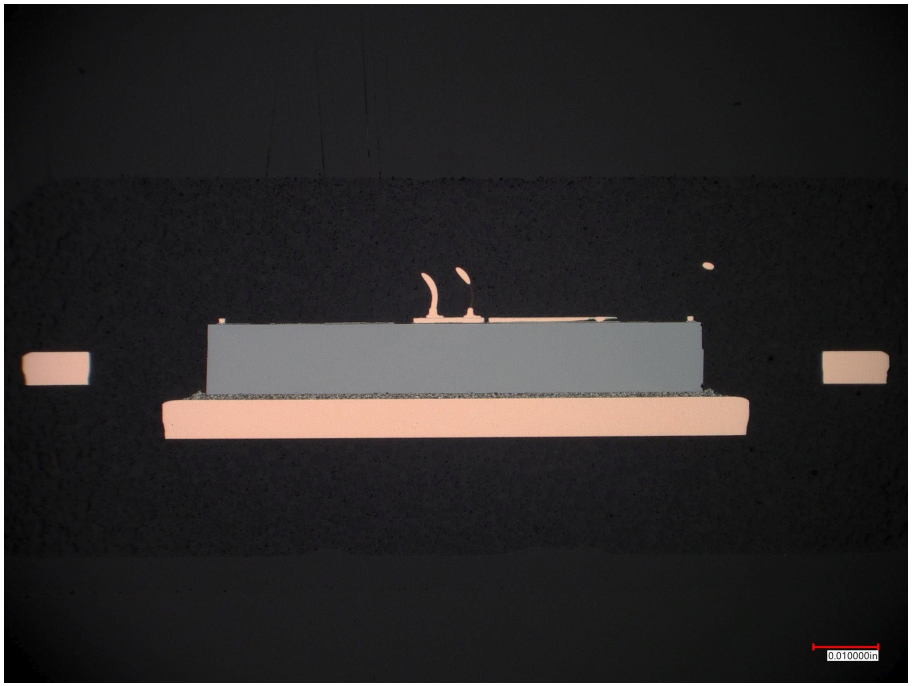
3



Overall view of sectioned device.

Sample Number

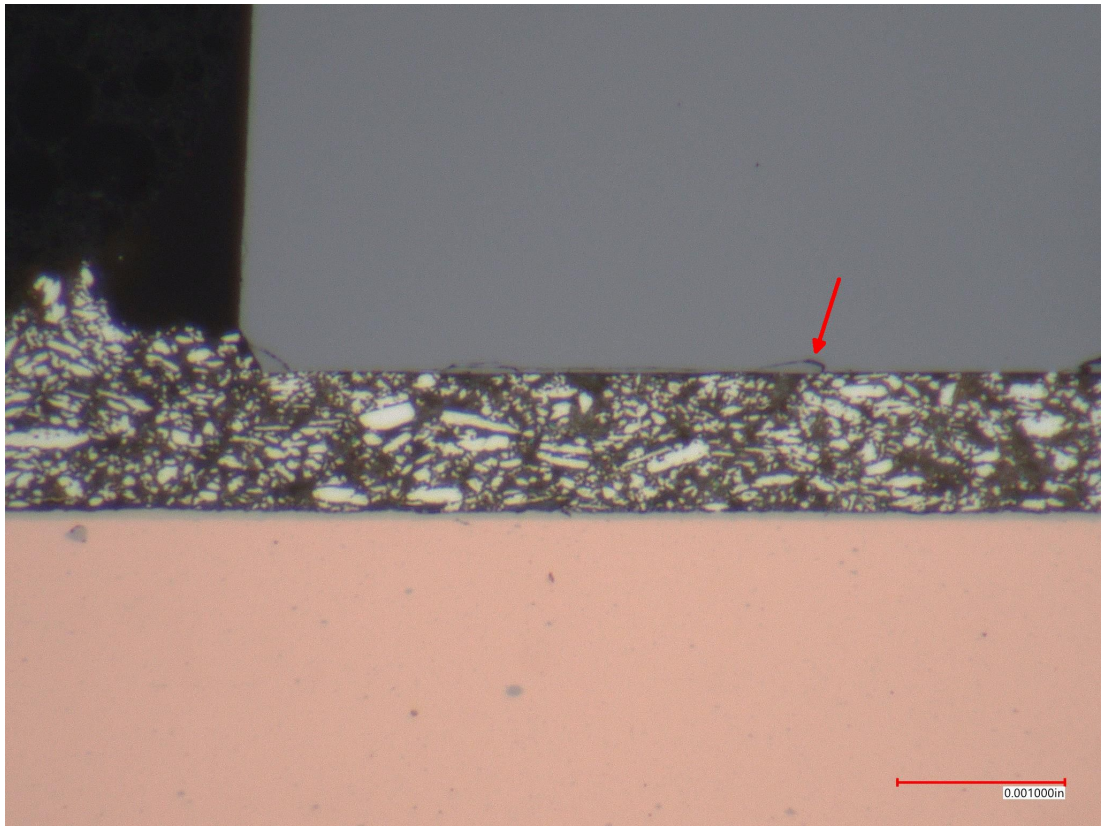
3



Detailed view of sectioned device.

Sample Number

3

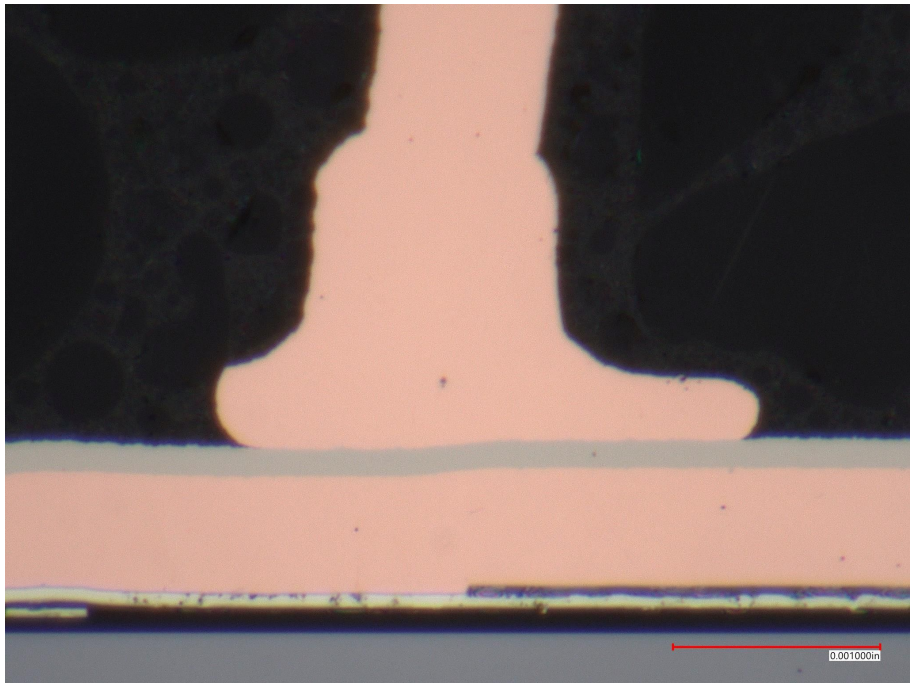


Detailed view of sectioned attach.

Arrow denotes cracks in die.
Induced during testing.

Sample Number

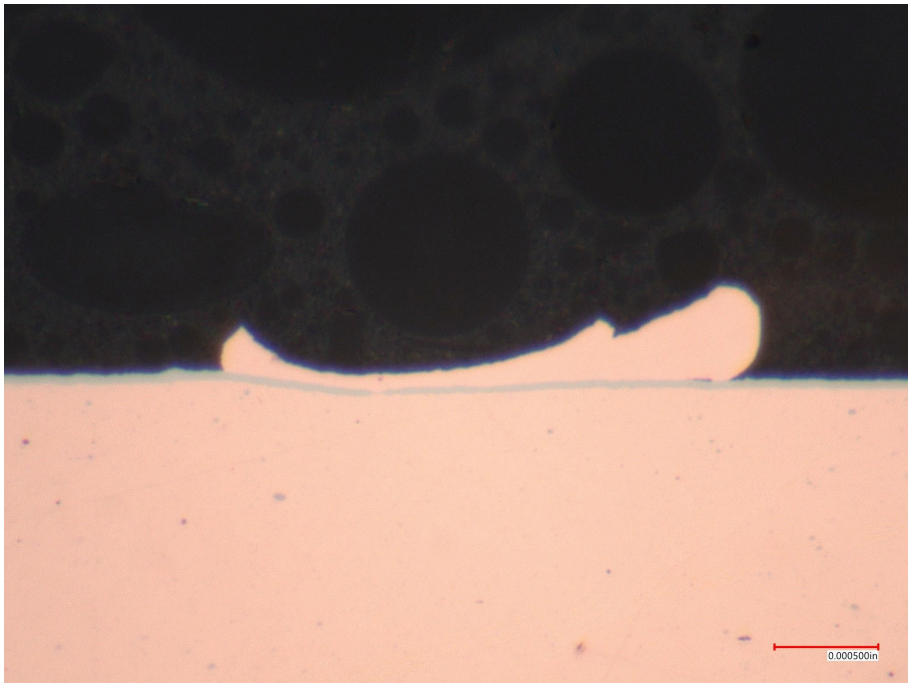
3



Detailed view of sectioned die bond.

Sample Number

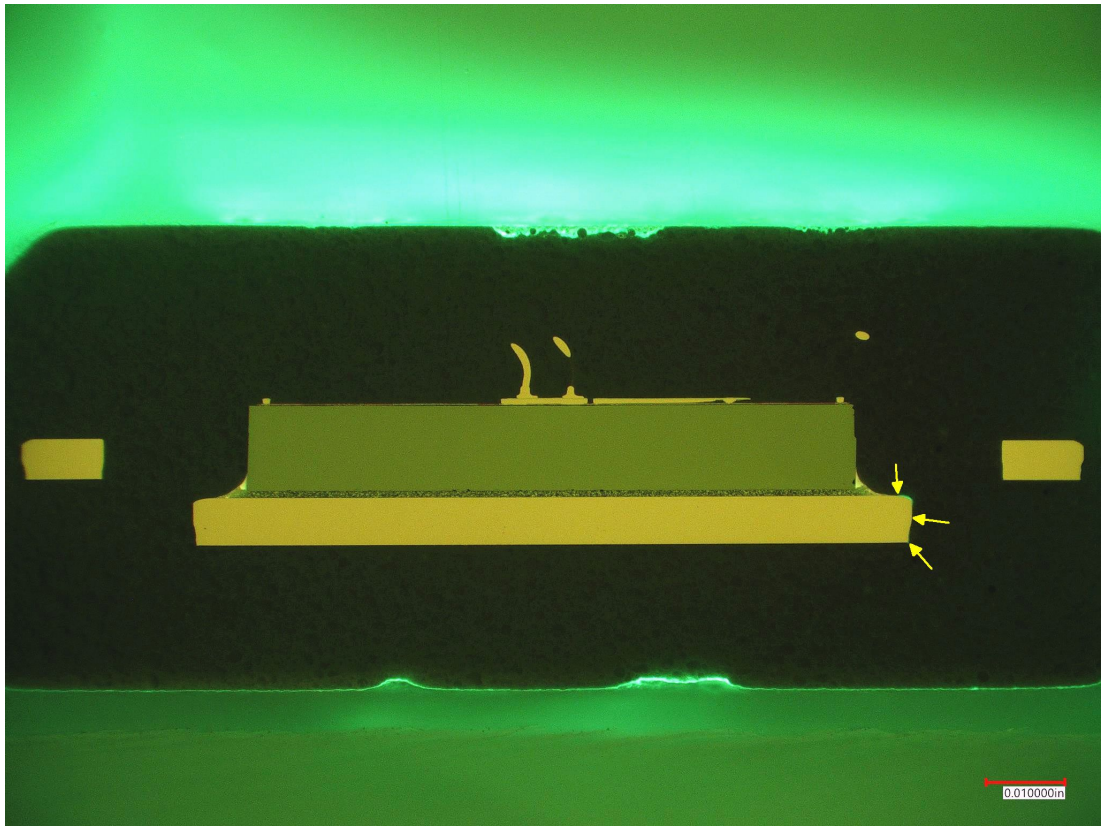
3



Detailed view of sectioned post bond.

Sample Number

3

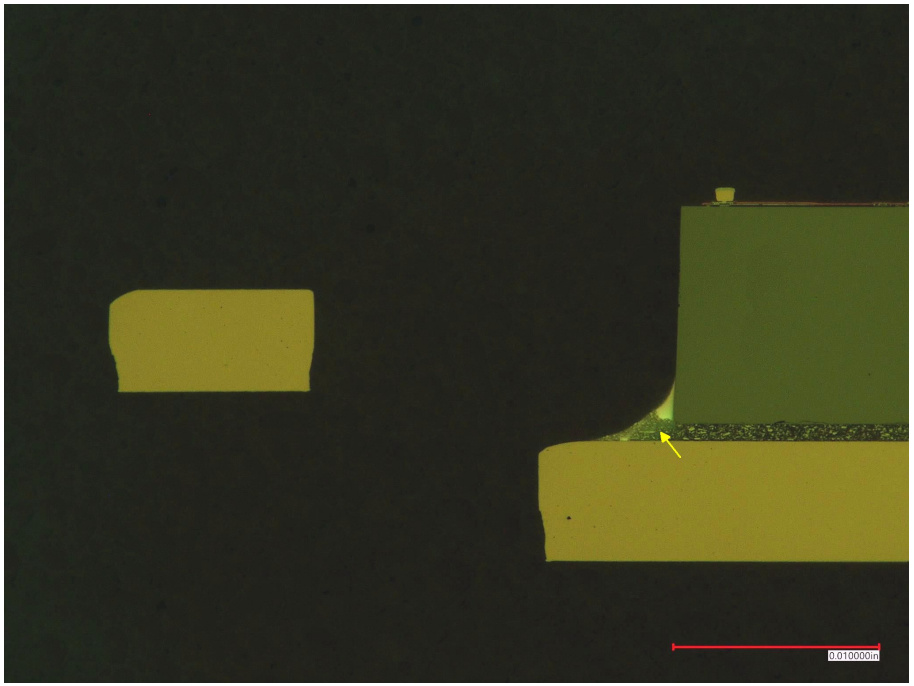


Overall view of sectioned device illuminated by black light.

Arrows denote dye penetration into package.
Customer Review.

Sample Number

3

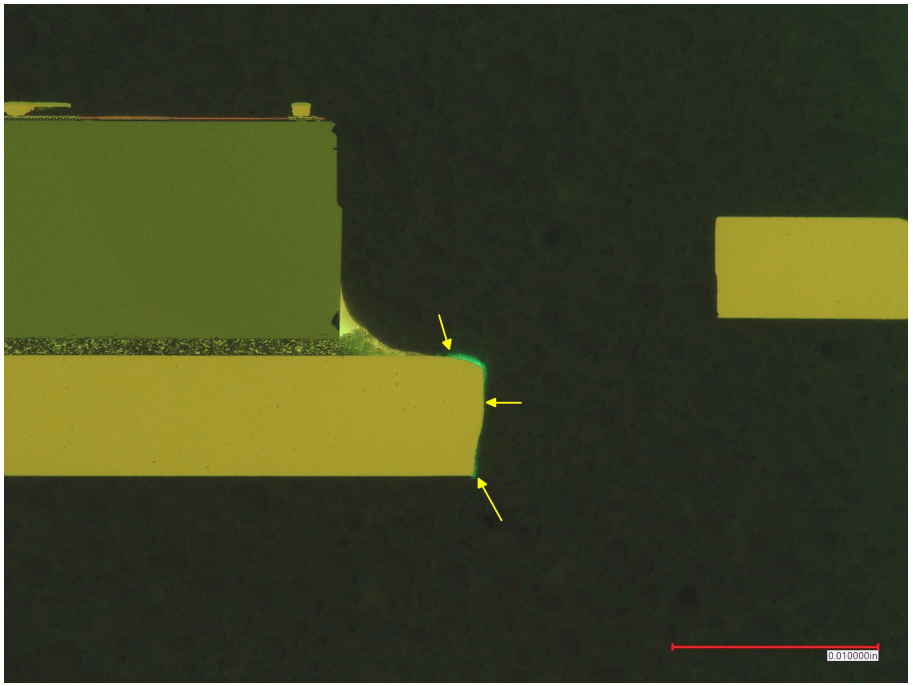


Detailed view of sectioned device illuminated by black light.

Arrows denote dye penetration into package.
Customer Review.

Sample Number

3

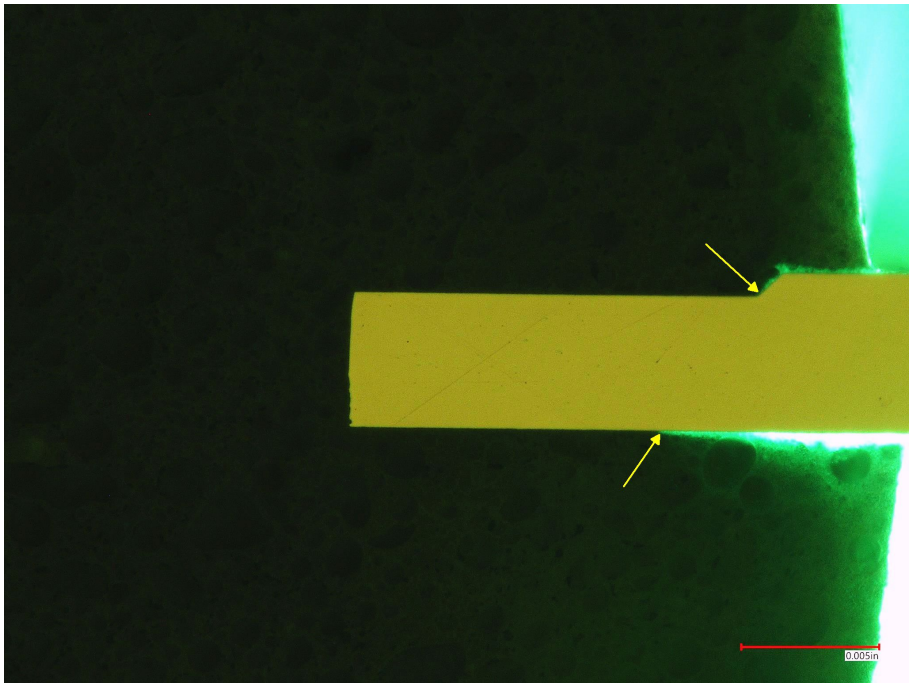


Detailed view of sectioned device illuminated by black light.

Arrows denote dye penetration into package.
Customer Review.

Sample Number

3

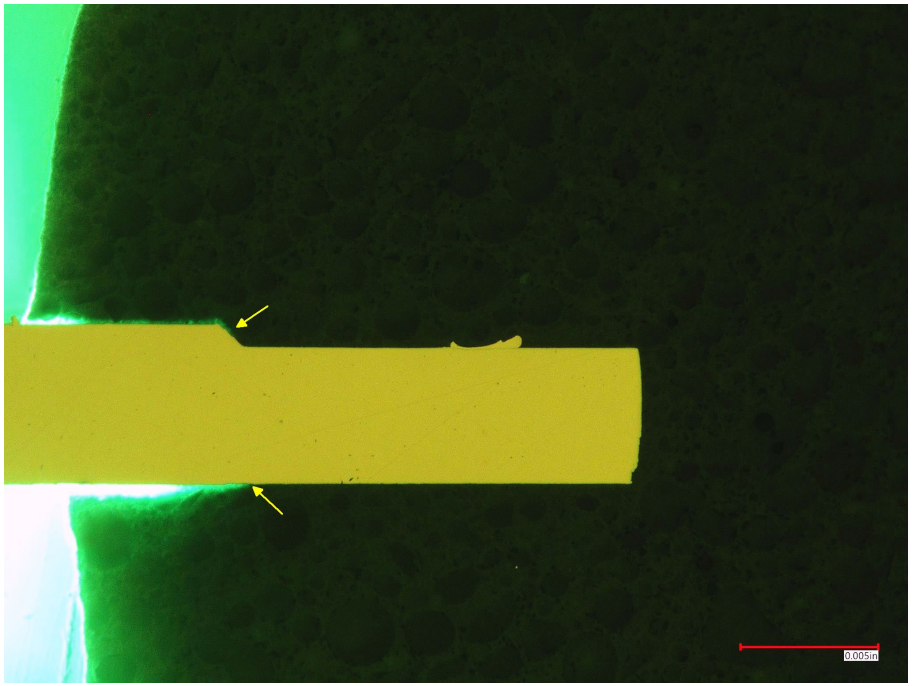


Detailed view of sectioned device illuminated by black light.

Arrows denote dye penetration into package.
Customer Review.

Sample Number

3



Detailed view of sectioned device illuminated by black light.

Arrows denote dye penetration into package.
Customer Review.

Bond Pull

Disposition: Acceptable

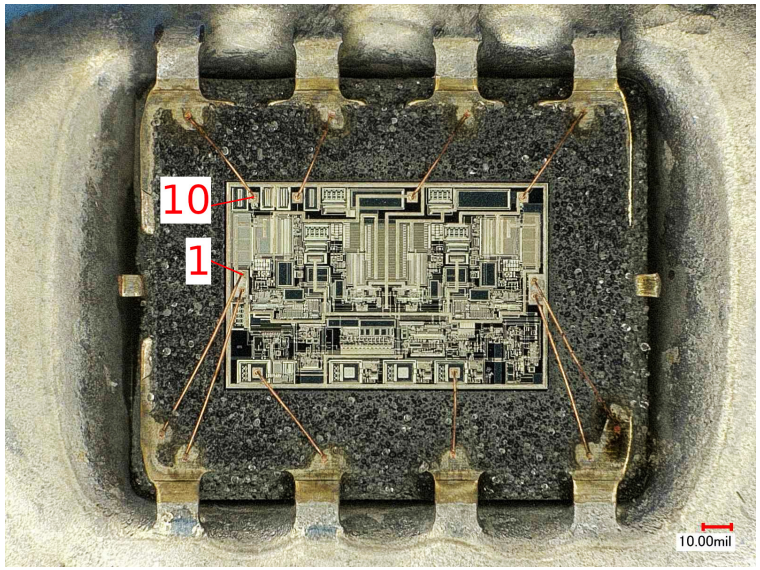
Performed per: Para. 16.5.1.8

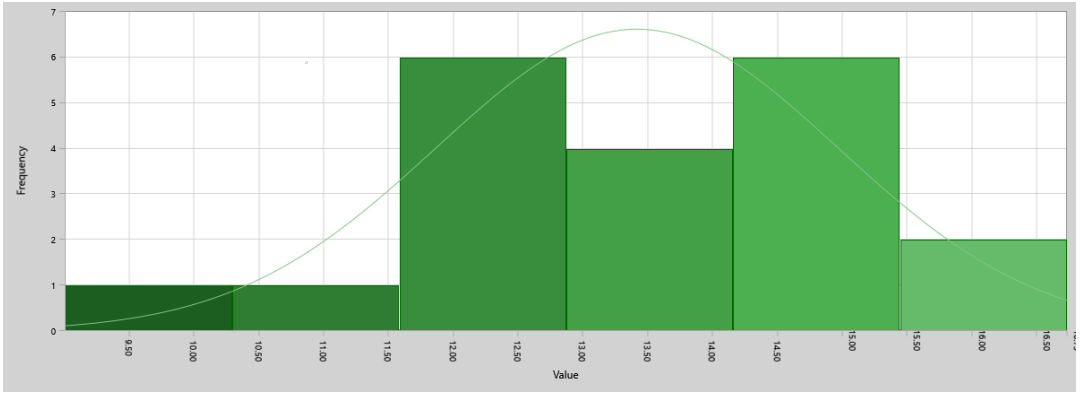
Internal Metallization System
Die Metallization: Al
Wire: Cu
Wire Diameter: 1.0 mils

Bonds Tested To:
☒ Destruction
Specified minimum: 2.5 grams
☐ Non-destruct to: grams

Pull Configuration
☒ As shown on this slide
☐ See slide
☐ Standard pin out

Sample Numbers Tested 1, 2





Full Data Set

4/18/2022

Josh Payne
Inspector

Date

Form 125 Rev B E# 235 Cal Due 1/6/2023

Bond Shear

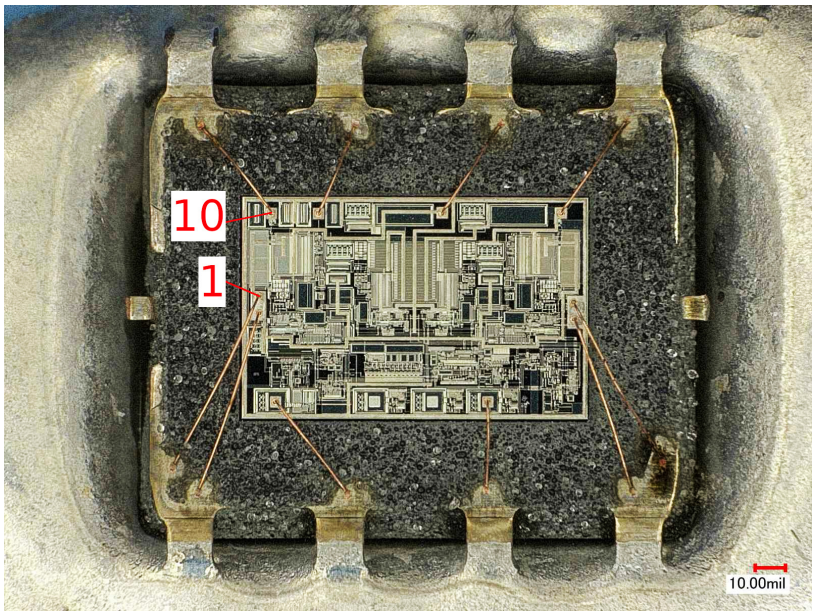
Disposition: Acceptable

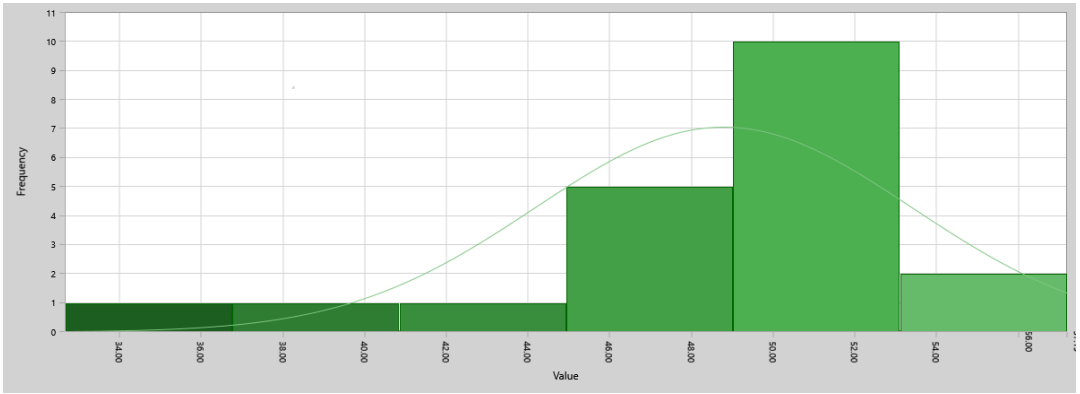
Performed per: Para. 16.5.1.7

Internal Metallization System	
Ball: Cu	Pad: Al
Ball Height:	mils
Average Diameter: 2.7	mils

Recommended Minimum Strength	
Individual: 15.6	grams
Average: 24.4	grams

Shear Configuration
☐ As shown on this slide
☐ See slide
☐ Standard pin out





Sample # 1, 2

Full Data Set

4/18/2022

Josh Payne
Inspector

Date

Form 126 Rev D E# 235 Cal Due 1/6/2023

Internal Visual Inspection - Microcircuit

Disposition: Acceptable

Performed per: PARA. 16.5.1.9 AND 16.5.1.6.1.b

Sample Number	Glassivation Integrity			
2				
A				

X. Induced during handling
Y. Induced during testing
Z. Induced at IGA

* Meets Acceptance Criteria
**
Δ Customer Review

Form 118 Rev B

Anomalies

A. No Anomalies

B. Bonds
1. Encapsulated in seal material
2. Misaligned to pad
3. Over entering/exiting metallization
4. Placed on attach or foreign material
5.

C. Die Defects
1. Chipout(s)
2. Crack(s) pointing towards or in active area
3. Diffusion anomaly
4. Glassivation crack(s)
5. Glassivation void(s)
6. Metallization bridging
7. Metallization corrosion
8. Metallization peeling
9. Multiple lines or complete absence of passivation continuing under metallization
10. Oxide void(s)
11. Shooting metallization
12. Scratch
13.

D. Die Mounting Defects
1. Attach material extending onto die surface
2. Inadequate bonding material around die perimeter
3. Void(s) in attach material
4.

E. Foreign Material
1. Attached
2. Chemical processing material
3. On surface
4.

F. Wire Defects
1. Bent wire(s)
2. Broken wire(s)
3. Crossing wires
4. Excess wire loop height
5. Straight line run (no stress relief)
6. Low wire clearance
7.

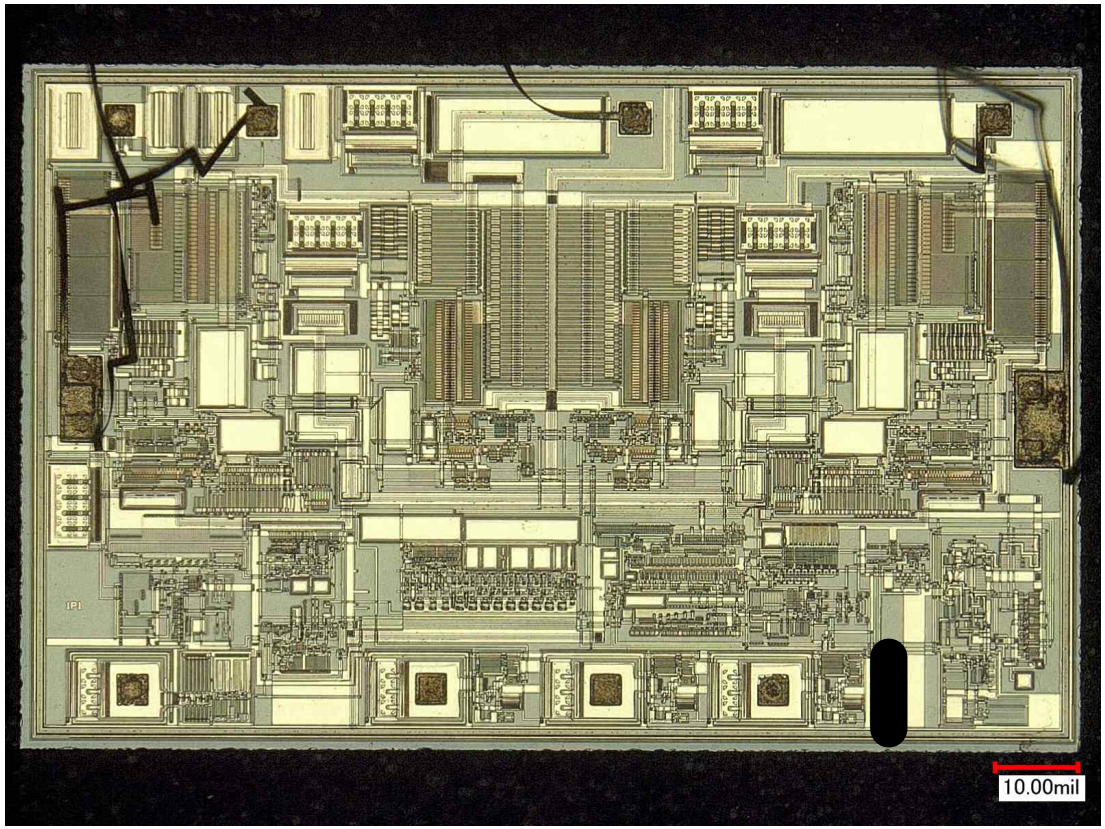
G. Other
1. Dye penetration into package
2.
3.

William Collins 4/25/2022

Bill Collins, Inspector — Date

Sample Number

2



Overall view of die after glassivation integrity.

Scanning Electron Microscopy (SEM)

Disposition: Rejectable

Performed per: PARA 16.5.1.10

Glassivation Removal	
☒ Chemical Wet Etch	☐ Dry Plasma Etch
☐ Other:	☐ Not Applicable

Lori Quen

Sample Number

Level	1	2			
M1	C2	C2			
M2	C2	C2			

\+ Cross-section revealed acceptable step coverage
X. Induced during handling
Y. Induced during testing
Z. Induced at IGA

* Meets Acceptance Criteria
**
Δ Customer Review

Form 233 Rev G E# 144 Cal Due 5/8/2022

Anomalies

A. No Anomalies

B. Silicon Nodules

C. Thinning Metallization
1. For directional contacts, contacts with < 10% wraparound, the metallization coverage shall be ≥ 50%
2. For multi-directional contacts, contacts with > 10% wraparound, the metallization coverage shall be ≥ 20%

D. Tunneling

E. Voids in Metallization

F. Notching

G. Construction Exemptions
1. Device exhibits planar oxide construction which does not require inspection in accordance with MIL-STD-883-2, Method 2018, paragraph 1
2. Device does not exhibit expanded metallization contacts or interconnects. Inspection is not required in accordance with MIL-STD-750-2A, Method 2077, paragraph 1.

H.

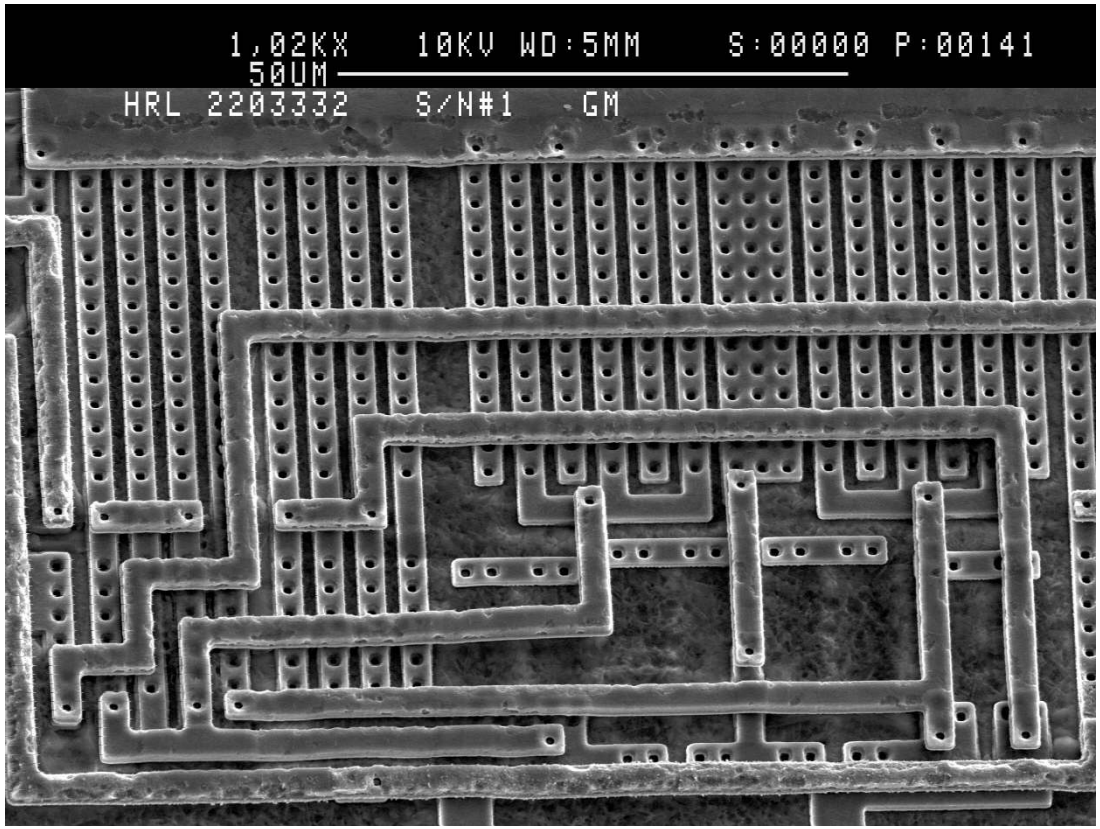
L Quen 4/28/2022

Lori Quen
Inspector

Date

Sample Number

1

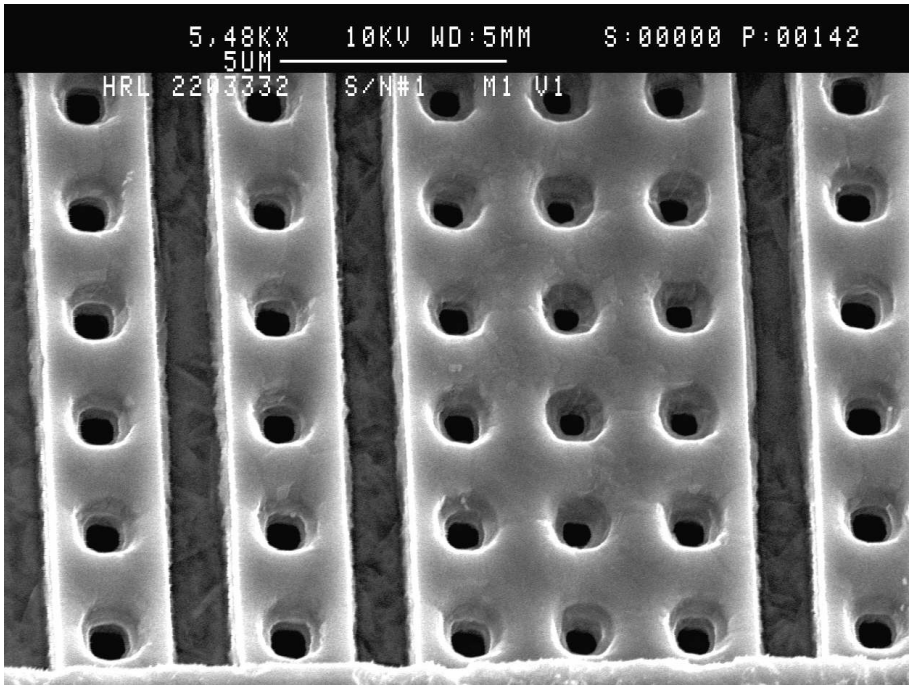


General metallization coverage.

Note thinning metal.
Rejectable.

Sample Number

1

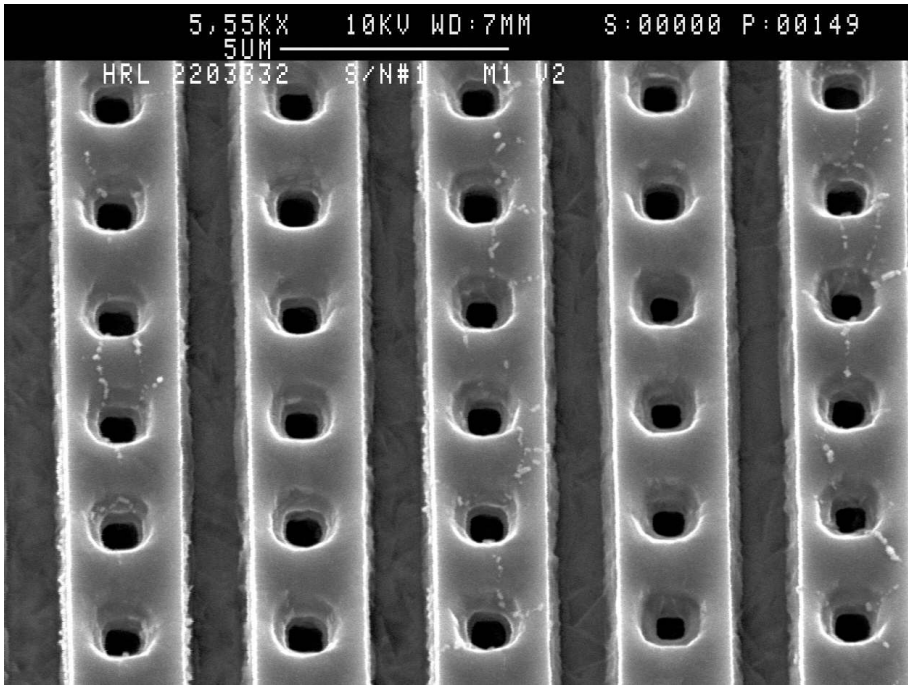


Worst case step coverage, Metal 1.

Note thinning metal.
Rejectable.

Sample Number

1

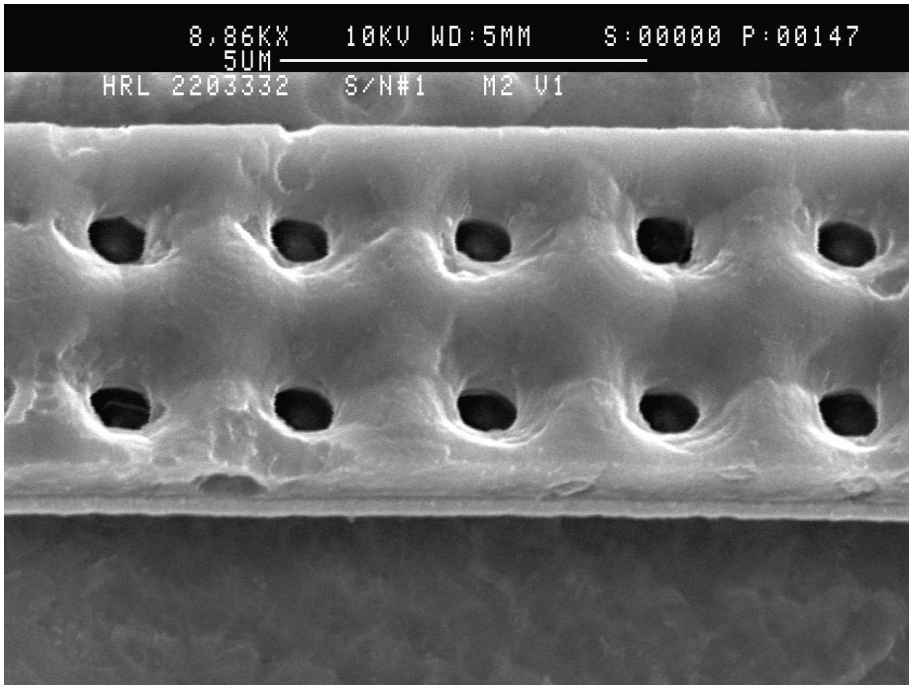


Worst case step coverage, Metal 1, rotated 90°.

Note thinning metal.
Rejectable.

Sample Number

1

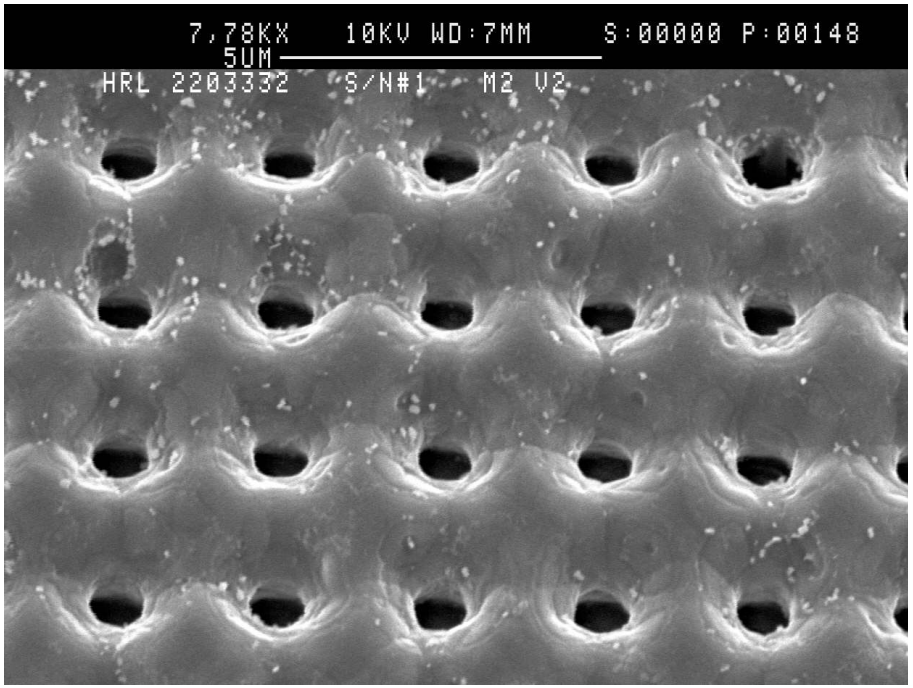


Worst case step coverage, Metal 2.

Note thinning metal.
Rejectable.

Sample Number

1

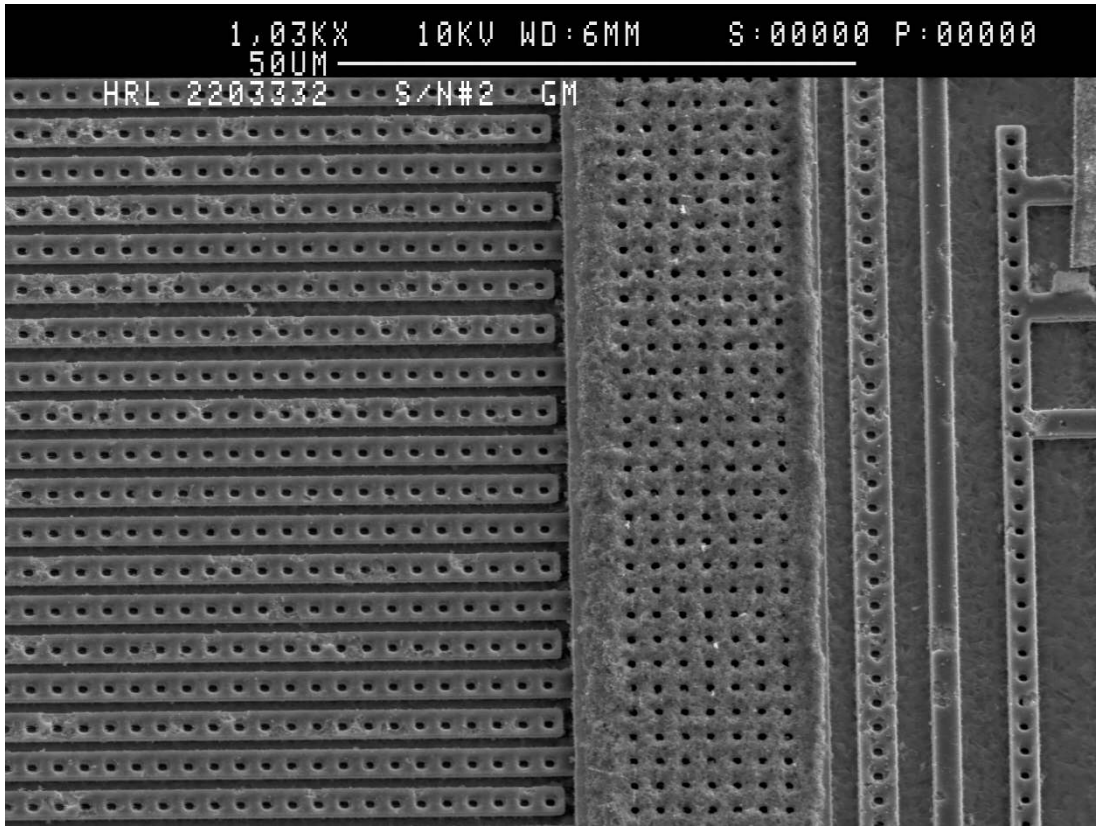


Worst case step coverage, Metal 2, rotated 90°.

Note thinning metal.
Rejectable.

Sample Number

2

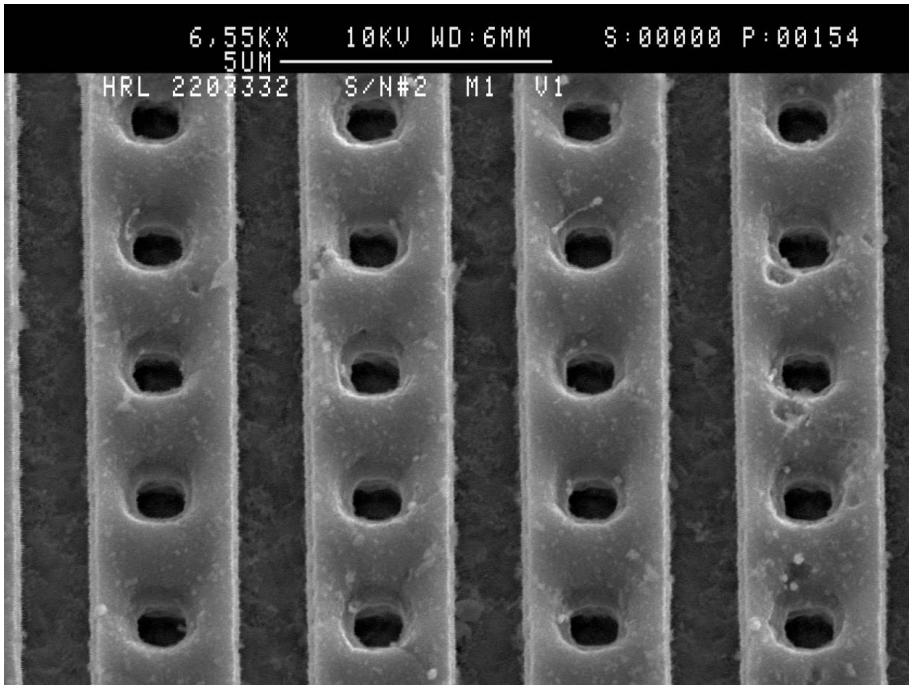


General metallization coverage.

Note thinning metal.
Rejectable.

Sample Number

2

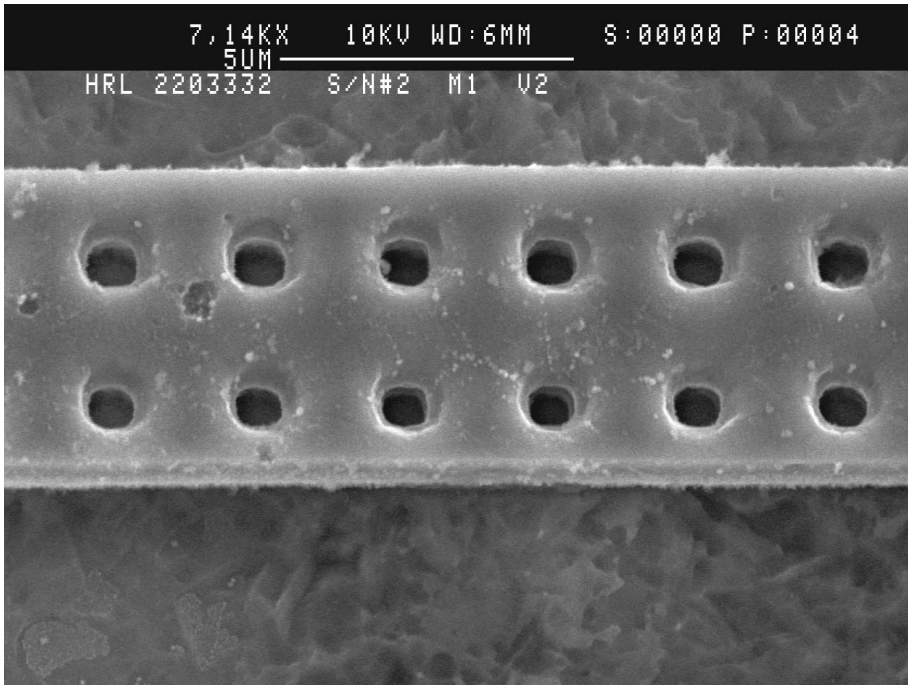


Worst case step coverage, Metal 1.

Note thinning metal.
Rejectable.

Sample Number

2

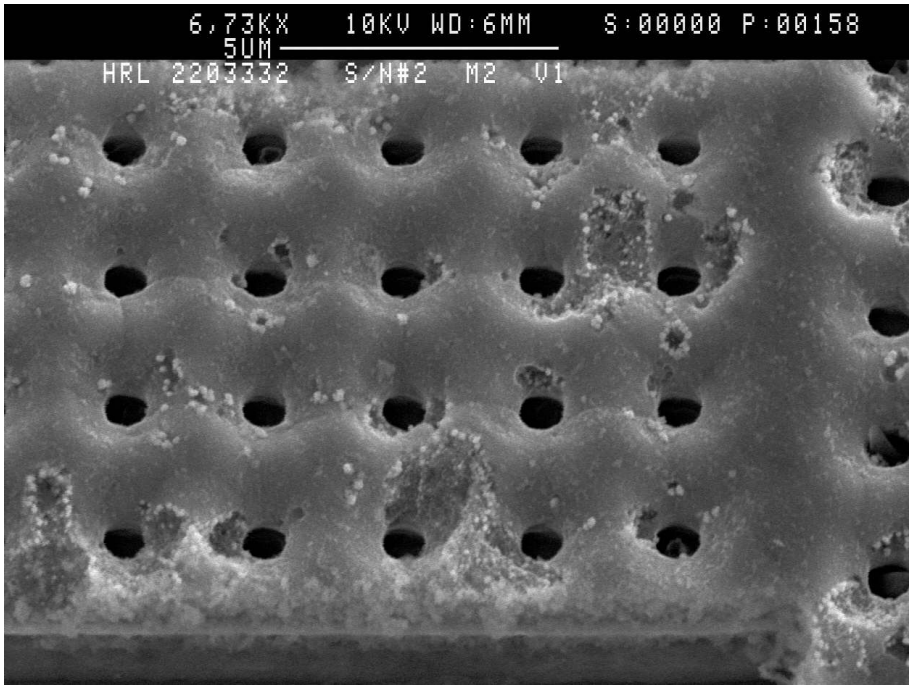


Worst case step coverage, Metal 1, rotated 90°.

Note thinning metal.
Rejectable.

Sample Number

2

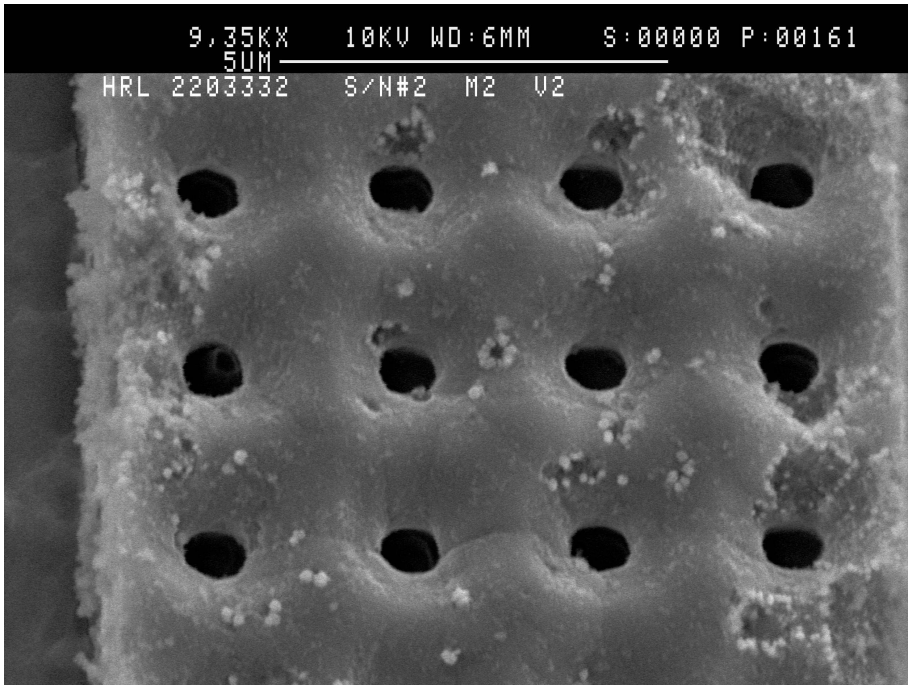


Worst case step coverage, Metal 2.

Note thinning metal.
Rejectable.

Sample Number

2

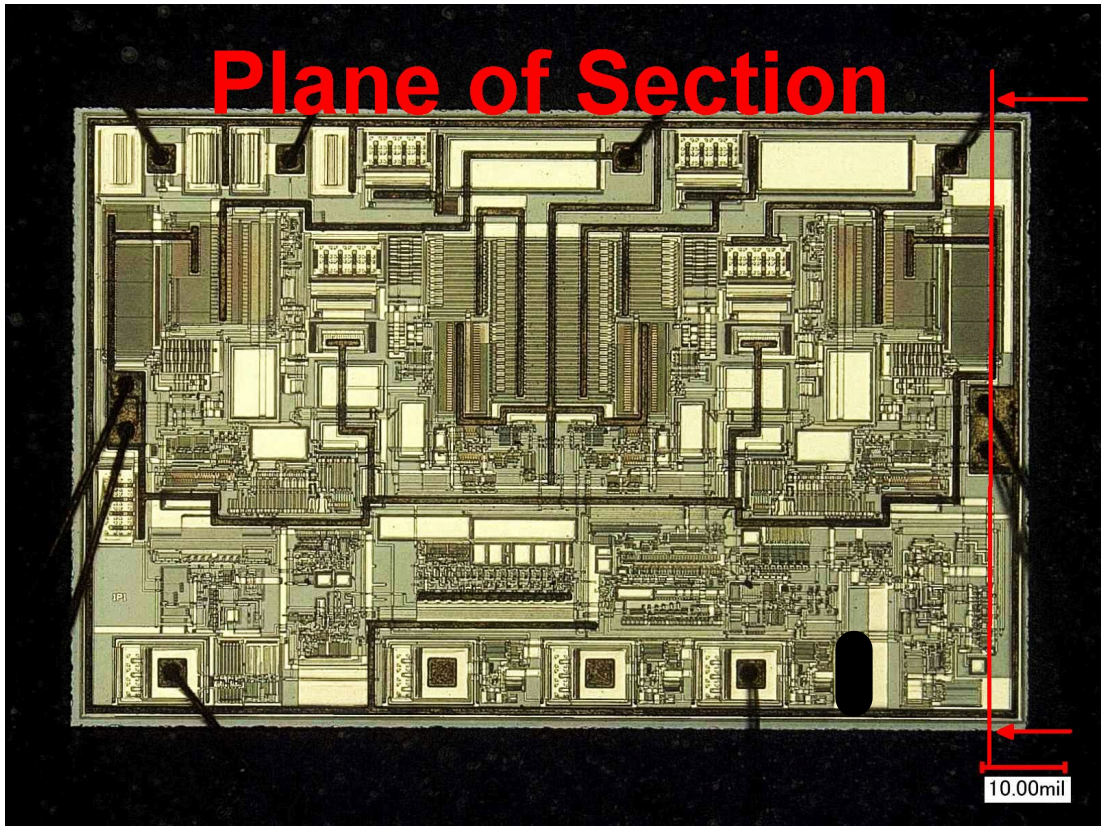


Worst case step coverage, Metal 2, rotated 90°.

Note thinning metal.
Rejectable.

Sample Number

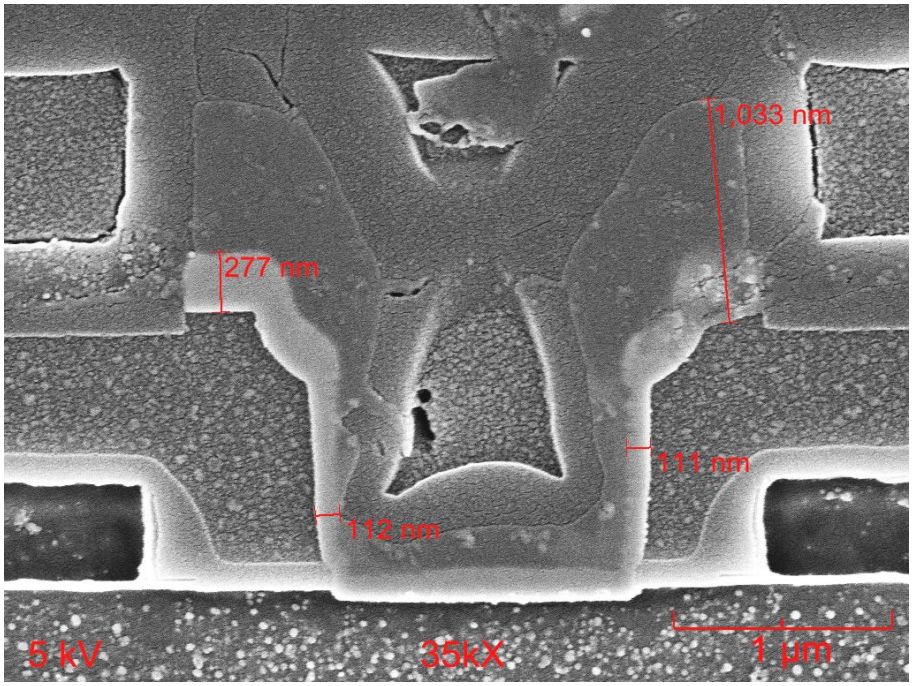
3



Overall view of die showing plane of section.

Sample Number

3

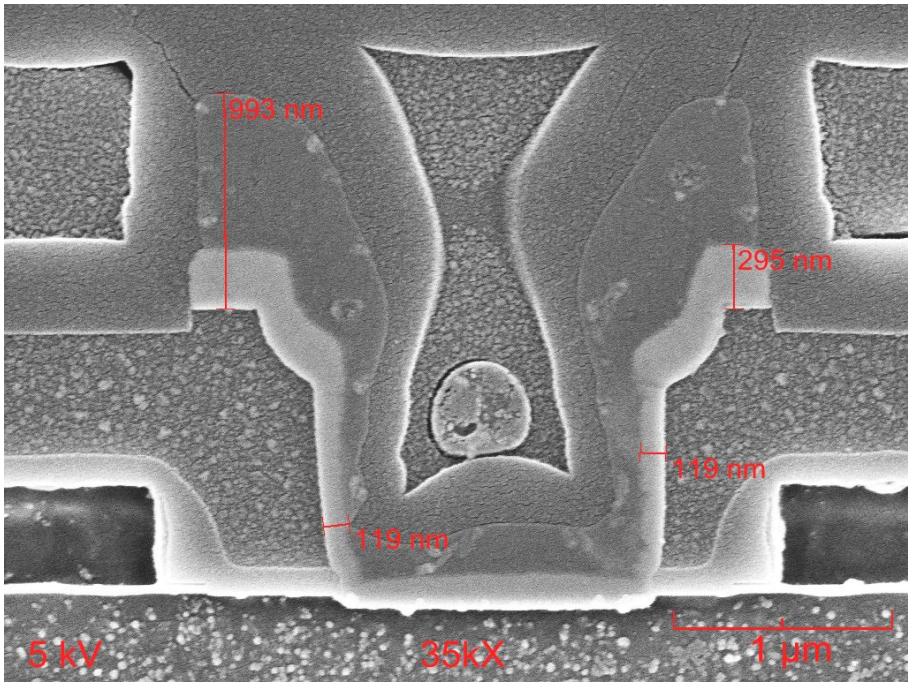


SEM micrograph of sectioned Metal 1 contact.

Note 11% metal remaining.
Rejectable.

Sample Number

3

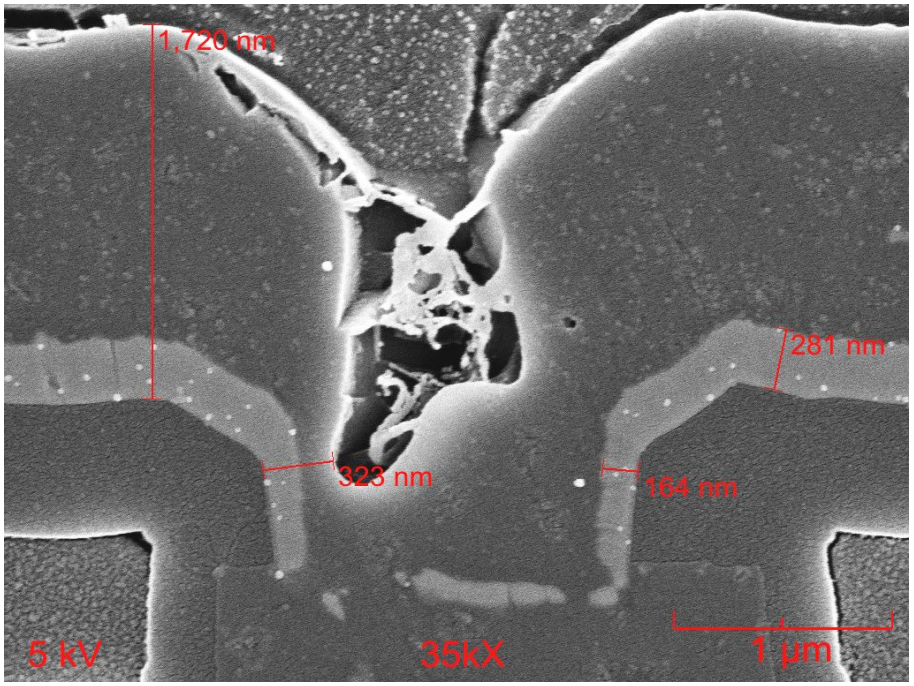


SEM micrograph of sectioned Metal 1 contact.

Note 12% metal remaining.
Rejectable.

Sample Number

3

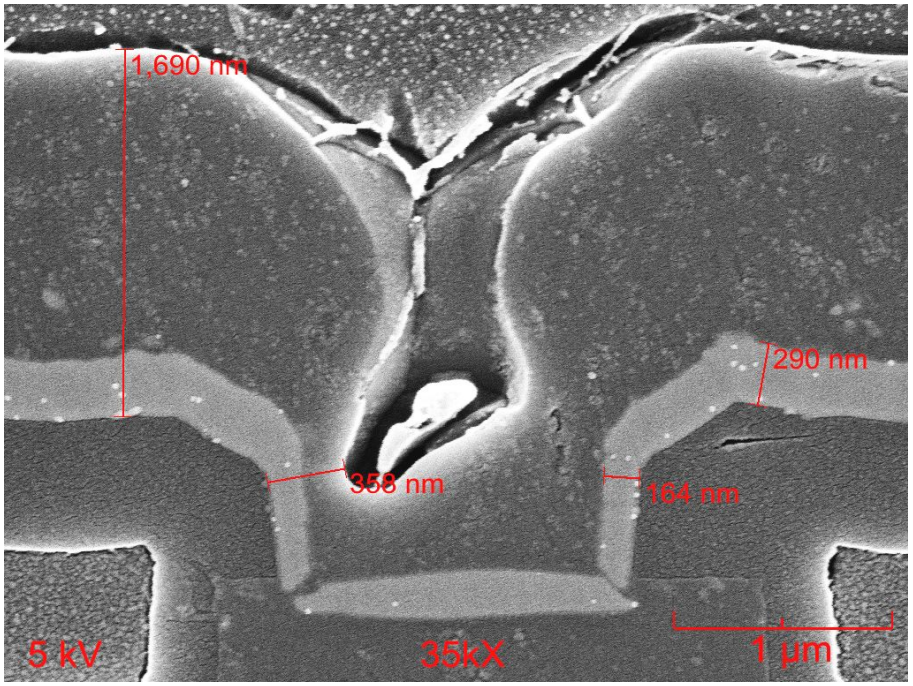


SEM micrograph of sectioned Metal 2 via.

Note 19% metal remaining.
Rejectable.

Sample Number

3



SEM micrograph of sectioned Metal 2 via.

Note 21% metal remaining.
Rejectable.

Hi-Rel Laboratories Routing Sheet Job Number 2203332

Part Plan Plastic Encapsulated Microcircuits and Semiconductors **Part Number**
Customer **Part Type** Microcircuit, plastic
PO Number **Manufacturer**
Tracer Number **Date Code** unknown
Quantity 3

PREPARED BY Dawn Skeman REVIEWED BY Jared Finney

THE FOLLOWING TASKS WERE PERFORMED IN ACCORDANCE WITH THE APPROVED MASTER PLANNING DOCUMENTS, NO: **MIL-STD-1580C Requirement 16.5**

TASK	PERFORMED TO	QUANTITY TO TEST	IN	OUT	DATE	TECH
EXTERNAL VISUAL INSPECTION	PARA. 16.5.1.1	ALL	3	3	3/28/2022	KS
EXTERNAL PHOTO DOCUMENTATION	HRL ITP 20040	TBD	3	3	3/28/2022	ZX
EXTERNAL PROHIBITED MATERIALS ANALYSIS	REQUIREMENT 9	ONE	3	3	3/28/2022	SF
RADIOGRAPHY	PARA. 16.5.1.2	ALL	3	3	3/29/2022	AA
ACOUSTIC MICROSCOPY	PARA. 16.5.1.3	ALL	3	3	3/31/2022	AJB
DYE PENETRANT INSPECTION	PARA. 16.5.1.4	ONE	3	3	4/28/2022	KDJ
CROSS SECTION	PARA. 16.5.1.4	ONE	3	3	4/28/2022	KDJ
DECAPSULATION	PARA. 16.5.1.5	REMAINING DEVICES	3	3	4/4/2022	PN
INTERNAL VISUAL INSPECTION	PARA. 16.5.1.6	ALL	3	3	4/12/2022	BC
INTERNAL PHOTO DOCUMENTATION	HRL ITP 20230	ALL	3	3	4/12/2022	SL
BOND PULL TESTING **(SEM ALL LIFTS)**	PARA. 16.5.1.8	ALL	3	3	4/18/2022	jp
WIRE BOND BALL SHEAR TEST	PARA. 16.5.1.7	TWO (20 BONDS)	3	3	4/18/2022	jp
INTERNAL PROHIBITED MATERIALS ANALYSIS	REQUIREMENT 9	ONE	3	3	NR	AG
GLASSIVATION LAYER INTEGRITY	PARA. 16.5.1.9 AND 16.5.1.6.1.b	ONE OR 20%	3	3	4/25/2022	BC
GLASS REMOVED **(NOT GLASS. INTEG. SAMPLE)**	HRL ITP 20320	TWO MINIMUM	3	3	4/26/2022	LQ
SEM	PARA. 16.5.1.10	TWO MINIMUM	3	3	4/28/2022	LQ
CROSS SECTION FOR THINNING METALLIZATION	PARA. 16.5.1.10.a	TBD	3	3	4/29/2022	JF

Form 132A Rev D

Hi-Rel Laboratories Routing Sheet Job Number 2203332

Part Plan Plastic Encapsulated Microcircuits and Semiconductors
Part Number
Customer
Part Type Microcircuit, plastic
PO Number
Manufacturer
Tracer Number
Date Code unknown
Quantity 3

PREPARED BY Dawn Skeman REVIEWED BY Jared Finney

THE FOLLOWING TASKS WERE PERFORMED IN ACCORDANCE WITH THE APPROVED MASTER PLANNING DOCUMENTS, NO: **MIL-STD-1580C Requirement 16.5**

TASK	PERFORMED TO	QUANTITY TO TEST	QUANTITY IN	QUANTITY OUT	DATE	TECH
DATA REVIEW AND FINAL REPORT	HRL ITP 10040		3	3	4/29/2022	MU
PACKAGING	HRL ITP 10050		3	3	4/29/2022	MU
QUALITY ASSURANCE REVIEW	HRL ITP 10060		3	3	4/29/2022	

Form 132A Rev D