

**Document Name****ERMA #**

Failure Analysis Final Report

27199

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	Date of Report	10 th April 2019
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	Evaluating Engineer	Alia Nabila Ismail

Contacts

Zawani Mohamad Yusof	Field:
	Corporate:

Device List (Legacy Products)

#	Device	Lot Number	Top Datecode	Top ID/ Bottom Mark	Failure
1	EP4CGX75DF27C7N	S902AF66	G CAAAF1901E	3N1GE9A0D	1
2	EP4CGX75DF27C7N	S849MKB7	G BAAAF1901E	3N9GE8Y00	6
3	EP4CGX75DF27C7N	S902AF66	G CAAAF1901E	3N1GE9A0D	6

Failure Mechanism Codes

1	No Trouble Found	5	Test Coverage	9	Unknown Cause	13	Corrupted Imprint
2	Electrical Overstress	6	Fabrication Defect	10	Component Design	14	Untestable
3	Electrostatic Discharge	7	Delamination	11	Package	15	Other (Specify)
4	Retention	8	Programmer	12	Factory Error	16	Control Unit

History of Failure

Reported Failure:

End Customer : CISCO

Customer found 1pce Dagger failed at 2C test with failure code "GET_ROMMON" , and based on the failure symptom as failed log shows and debug preliminary analysis(eliminated process issue after visually inspected and 2D/5D X-ray test) , the failure was related with U1_F1(FPGA), after they did A-B-A swap test, it is true component issue

Failure Rate: 0.286% (1 Out of 350 Devices)

Where Failure Occurred: Programming Board Assembly Board Inspection Board Test

End User Inspection Field After () Months Unknown Other (specify)

Other Relevant Information: N/A

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Analysis Methods Performed

Non-Invasive:		Invasive:	
<input checked="" type="checkbox"/> External Visual	<input type="checkbox"/> Design Review	<input type="checkbox"/> Decap Package	<input type="checkbox"/> Delayering
<input type="checkbox"/> X-Ray	<input type="checkbox"/> Verify on Bench	<input type="checkbox"/> IR Microscopy	<input type="checkbox"/> Cross Section
<input checked="" type="checkbox"/> C-SAM		<input type="checkbox"/> Liquid Crystal	<input type="checkbox"/> FIB
<input checked="" type="checkbox"/> Production Test		<input type="checkbox"/> EMMI / OBIRCH	<input type="checkbox"/> SEM
<input type="checkbox"/> IV Curve		<input type="checkbox"/> Microprobing	<input type="checkbox"/> EDX
<input type="checkbox"/> TDR			<input type="checkbox"/> Other (Specify)

Test Results (FPGA)

#	Opens	Shorts	Icc Standby	RAM	Functional	Comments
1	Pass	Pass	Pass	Pass	Pass	No trouble found
2	Pass	Pass	Pass	Pass	Failed	Unit failed functional test at 0°C and 25°C
3	Pass	Pass	Pass	Pass	Failed	Unit failed functional test at 0°C

Analysis Procedures and Results

Upon receiving, the marking on the returned devices were verified to be consistent against the Device Problem Report.

At visual inspection, the solder balls of the devices were found to be deformed as expected after device extraction from customer's board (Figure 1).

C-SAM inspection was performed on the returned devices and no anomaly were observed. (Figure 2)

After being baked to remove excess moisture, the devices were reworked with new solder balls.

All devices were then tested with Production Final Test Flow that tests for DC parametric and device functionality.

Device #1:

The device passed all test across all temperatures of 0°C, 25°C and 85°C. No failing behavior was observed on the device.

Device #2 and #3:

Device #2 and #3 failed functional tests at low temperatures. Additional characterization showed:

- Device#2 failed transceiver output buffer test and transceiver ICDR (Interpolator Clock Data Recovery) speed test at 25°C and 0°C.
- Device#3 failed transceiver output buffer test and transceiver ICDR (Interpolator Clock Data Recovery) speed test at 0°C only.

ICC values of both ERMA devices are comparable to factory standard device, this rules out an electrical overstress damage (EOS) as cause of functional failures.

The devices failure was believed to be caused by a random defect. Such a defect is introduced into the devices during the wafer fabrication process, and can cause a latent failure. This kind of fabrication defect is random in nature, and does not pose any concern for reliability of other devices.



Attached Pages

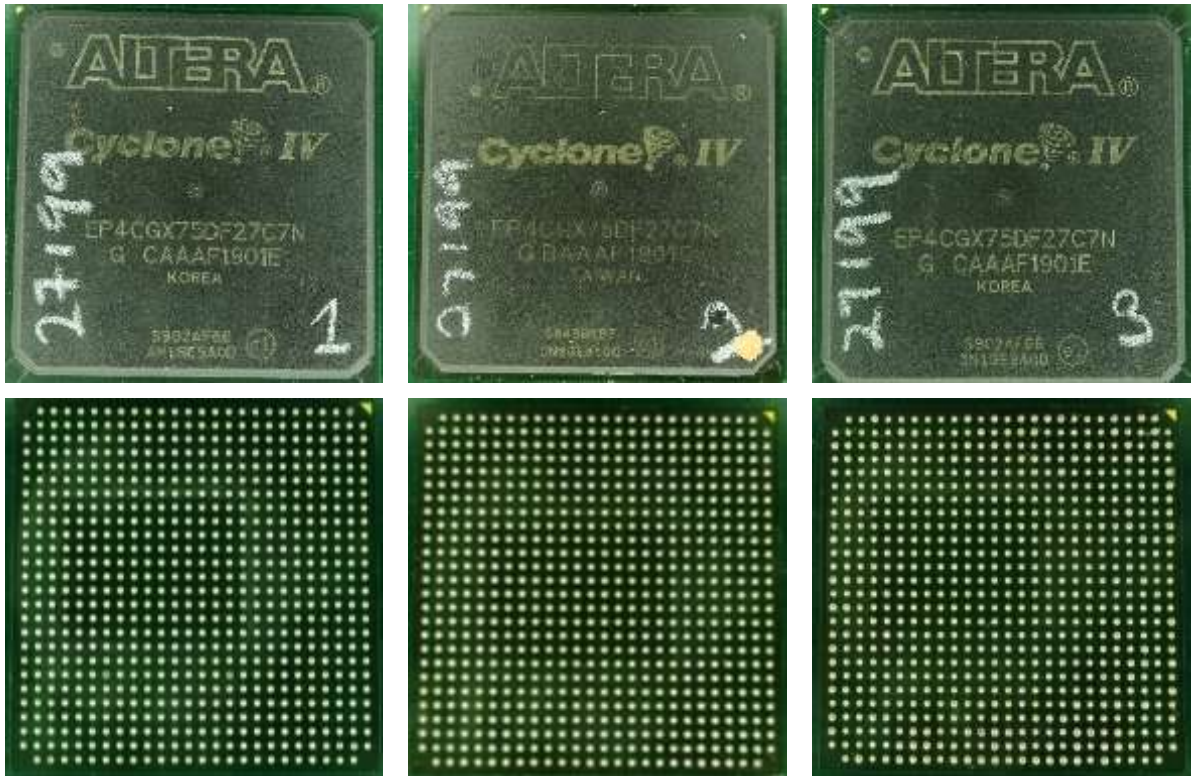
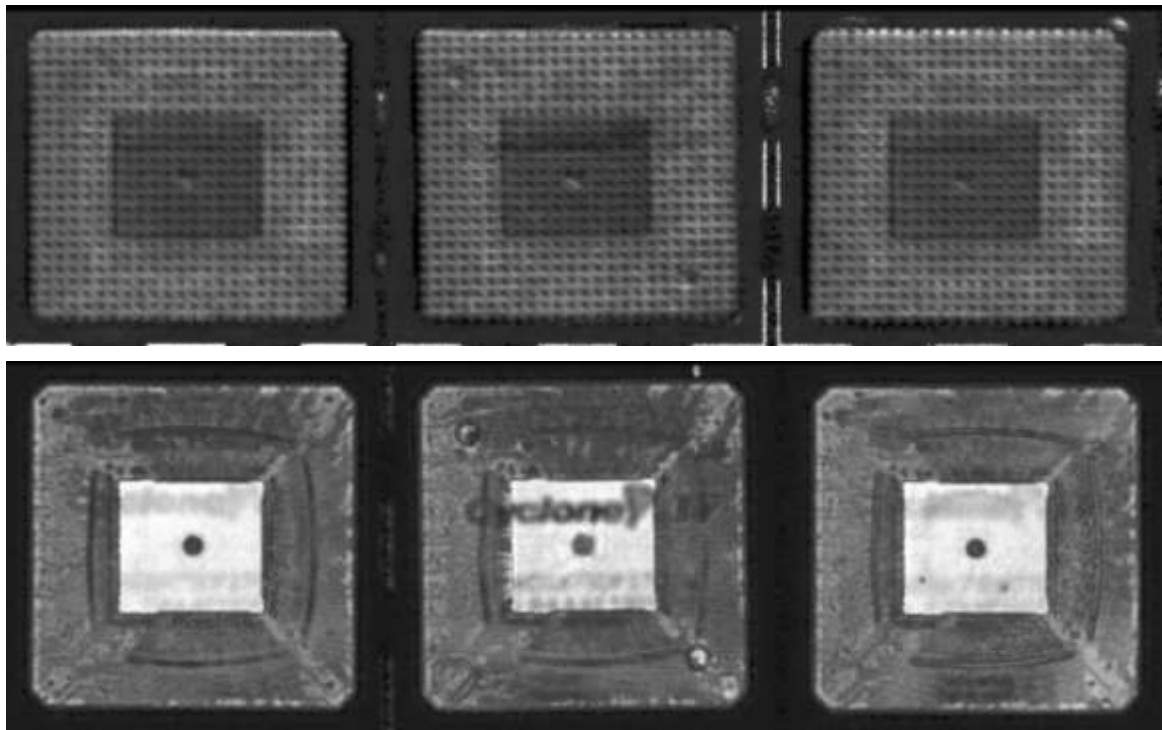


Figure 1: Top and bottom view of incoming ERMA devices.



Device #1

Device #2

Device #3


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Figure 2: C-SAM inspection on incoming ERMA devices.

Estimated Failure Rate of Problem

The Cyclone IV GX device was manufactured in a 65 nm process technology. The Reliability Monitor Life Test results demonstrate a combined failure rate of 10. One FIT is equivalent to one failure in one billion device-hours.

Plan for Reducing Incidence of Problem

Reliability monitors are performed on a regular basis in order to assure that normal production testing and process control methodologies produce reliable products. Intel PSG also has an on-going defect reduction program to improve yield and the quality of outgoing parts.

