Counterfeit Chips: What Are The Threats?

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Who Develops the IPs? Who Designs the ICs? Who Fabricates Them?
Who Develops the IPs? Who Designs the ICs? Who Fabricates Them?

Every Where!

IP Piracy

Hardware Trojans

Untrusted Foundry

IC Piracy

Counterfeit ICs

Rouge Designer
Reports of Counterfeits in the Last Ten Years

Counterfeit Incidents Reports, 2001 to 2011
GIDEP and ERAI

# Incidents

Year

'01 '02 '03 '04 '05 '06 '07 '08 '09 '10 '11

GIDEP
ERAI
Most Counterfeited Parts in 2011 (% of Reported Incidents)

- Analog IC: 32.4%
- Microprocessor IC: 25.2%
- Memory IC: 13.4%
- Programmable Logic IC: 13.1%
- Transistor: 8.3%
- Others: 7.6%

IHS reports a $169B annual risk
Applications and Threats

Thousands of chips are being fabricated and tested in untrusted foundries, assemblies, and supply chains.
Any Component can be Counterfeit
Taxonomy: Components

Components

Integrated Circuits

Analog
- Amplifiers
- Filters
- ADC / DACs
- Mixers, Phase Shifters

Digital

Discrete
- Resistors, Capacitors, Inductors, etc.
- Diodes/Transistors
- Sensors
- Relays/Switches
- Connectors
- etc.

Memory
- ROM
- SRAM, DRAM
- Flash, EPROM, etc.

Programmable Logic
- FPGA
- CPLD

Microprocessor
- Intel, AMD, ARM processors

ASIC
- IP Cores
- Microcontrollers
- DSPs, etc.
Recycled ICs

A recycling center → PCBs taken off of electronic systems → ICs taken off of PCBs

Critical Application

Resold as new

Identical:
Appearance, Function, Specification

Refine recycled ICs

Consumer trends suggest that more gadgets are used in much shorter time – more e-waste

Source: Images are taken from google
Design & Fabrication

GDSII
010010010111001
000010010011100
010101001001010
000001010011111
10000

IP Owner

Foundry

Over-produced ICs

Assembly

Market

Defective or Out-of-spec ICs
Current Manufacturing and Test

Designer

Test Patterns
Test Responses

Foundry & Assembly
Think Different!

Designer

Foundry & Assembly
Counterfeit Detection

Counterfeits are Defective
Testing for Defects
Detection and Avoidance

CHALLENGES / ROADMAPS
# Technology Gaps

<table>
<thead>
<tr>
<th></th>
<th>Obsolete Parts</th>
<th>Active Parts</th>
<th>New Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycled</td>
<td>70% EVI//HPVI/DNA/FT/ET</td>
<td>80% EVI/marking/HPVI/DNA</td>
<td>CDR Sensors, SST, Unique ID, PUF, Functional Locking Mechanisms, RON, Prevention, Etc.</td>
</tr>
<tr>
<td>Remarked</td>
<td>60% EVI/HPVI/FT/ET</td>
<td>60% EVI/HPVI/FT/ET</td>
<td>&gt;80%</td>
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<tr>
<td>Cloned</td>
<td>10% HPVI/FT/ET/PT</td>
<td>30% HPVI/FT/ET/PT</td>
<td></td>
</tr>
<tr>
<td>Over-produced</td>
<td>10% HPVI/FT/ET/PT</td>
<td>30% HPVI/FT/ET/PT</td>
<td></td>
</tr>
<tr>
<td>Out-of-spec</td>
<td>70% ET/PT</td>
<td>80% ET/PT</td>
<td></td>
</tr>
<tr>
<td>Defective</td>
<td>50% FT/PT</td>
<td>70% FT/PT</td>
<td></td>
</tr>
<tr>
<td>Tampered</td>
<td>10% FT/PT</td>
<td>30% FT/PT</td>
<td></td>
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</tbody>
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FT: Functional Test  
ET: Electrical Test  
HPVI: High Power Visual Inspection  
EVI: External Visual Inspection  
PT: Parametric Test
Technology Roadmap

1-3 Years
- Comprehensive Test Technology Assessment
- Develop Models and Tools to Guide Test Selection with Risk/Data/Cost
- Development of New Counterfeit Detection Techniques
- High Confidence Levels and Tests that End Counterfeiting
- Automate The Entire Detection to Reduce Overall Time/Cost
- Every New Chip Should be Equipped with Security Mechanism

3-5 Years
- Standardize the Test Process to Ensure Test Quality / Supply Chain
- Facilitate Collaboration between Government, Industry, and Academia
- Develop New Mechanisms to Stop Counterfeiting New Chips
- Continuous Monitoring of Counterfeit Trends and New Threats

5-10 Years
Conclusions

Counterfeit industry is growing and is here to stay

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