

Strategies to Eliminate Counterfeit IC's

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Outline

- What is the definition of a “Counterfeit Semiconductor?”
- Why do counterfeit semiconductors exist?
- Where do they come from?
- How big is the problem?
- What role is the government playing?
- What role are the standards agencies playing?
- What can be done to eliminate counterfeit parts?

“Counterfeit Semiconductor” Definition

- The term “Counterfeit” is a bit misleading in that it typically implies an exact copy of an item.
- The semiconductor “Counterfeit” problem is much broader than just an exact duplicate.
- The current definition of counterfeit material from the Department of Defense (DOD) is:
“Materiel whose identity or characteristics have been deliberately misrepresented, falsified, or altered without legal right to do so.”
- There is also a working definition being proposed by the SAE G-19 committee which states:
“A fraudulent part that has been confirmed to be a copy, imitation, or substitute that has been represented, identified, or marked as genuine, and/or altered by a source without legal right with intent to mislead, deceive, or defraud”

“Counterfeit Semiconductor” Definition

Under this definition, all of the following are considered “Counterfeit”:

Counterfeit Types:

1. Simple part number remarking
2. Speed grade alteration
3. Operating temperature range alteration
4. Changes to manufacturer and/or date code markings
5. Substitution of one die for another
6. Substitution of RoHS devices for Tin/lead
7. Representing discarded PCB board pulls as new
8. Redesigned exact copies of an original part

Why do Counterfeit Semiconductors exist?

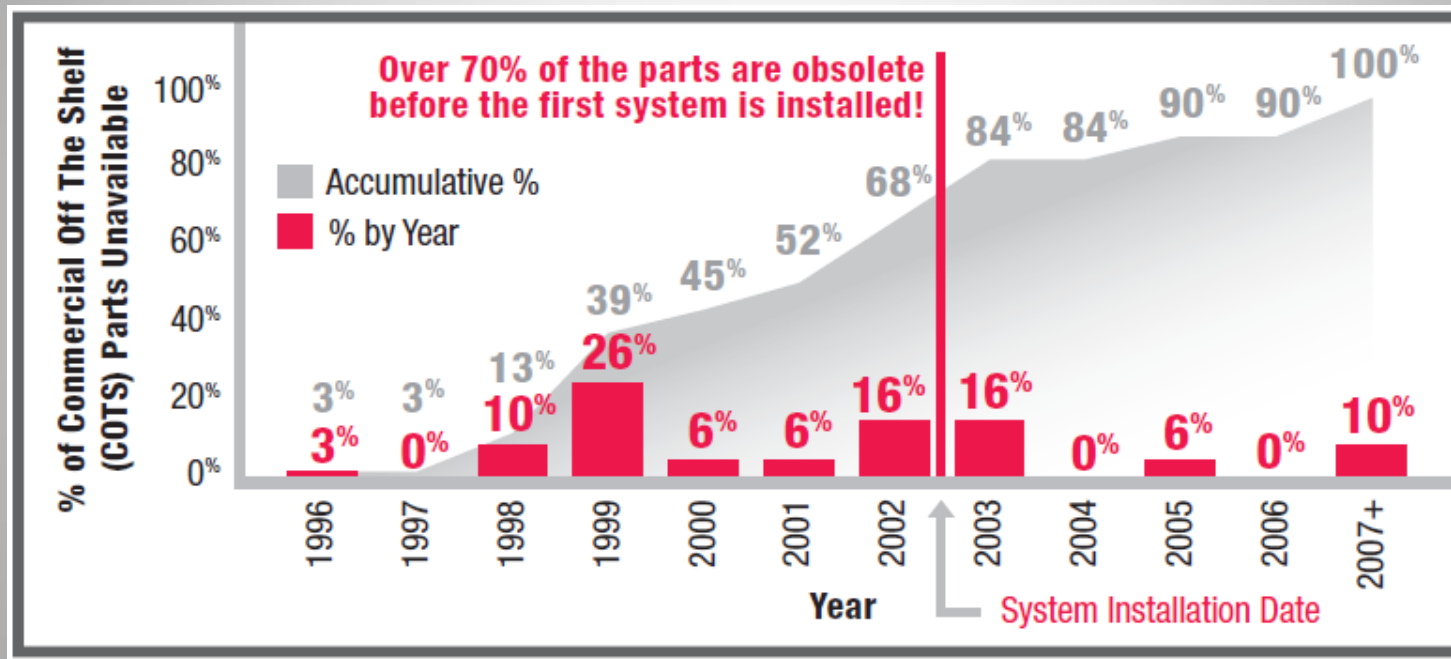
1. No product exists without a market.
2. The military and avionics markets need support for 15 to 40 years.
3. The semiconductor market is dominated by support for consumer devices.
4. Most consumer devices are designed to last 2 to 4 years.
5. Therefore most semiconductor devices are obsoleted in 3 to 5 years.

Because of the mismatch between #2 and #5, the market for obsolete parts will continue to grow – and the opportunity for counterfeiters to profit from this mismatch will grow with it.

Why do Counterfeit Semiconductors exist?



- Consider the chart below:



Source: NAVSURFWARCENDIV Crane, via Avnet

- With the increasing use of electronics in military and avionics applications, obsolescence is here to stay.

Why do Counterfeit Semiconductors exist?

- One might argue that the obsolescence issue has been with us since the 1950's when TI obsoleted it's first silicon transistor – so why is it such a huge problem today?
- The answer: e-Waste recycling! The number of electronic devices being recycled is increasing.

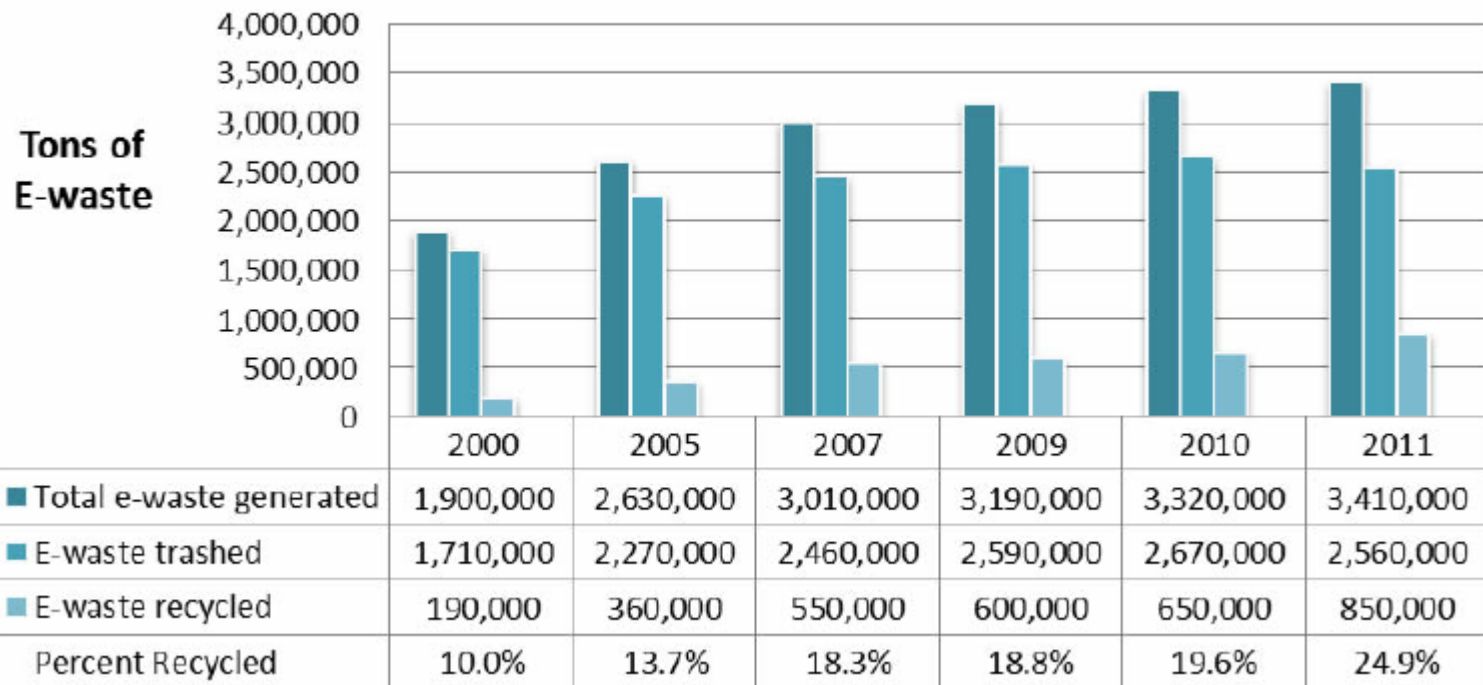
E-Waste by the UNIT in 2010 – Was it Trashed or Recycled				
Products	Total disposed**	Trashed	Recycled	Recycling Rate
	Units	Units	Units	%
Computers	51,900,000	31,300,000	20,600,000	40%
Monitors	35,800,000	24,100,000	11,700,000	33%
Hard copy devices	33,600,000	22,400,000	11,200,000	33%
Keyboards and Mice	82,200,000	74,400,000	7,830,000	10%
Televisions	28,500,000	23,600,000	4,940,000	17%
Mobile devices	152,000,000	135,000,000	17,400,000	11%
TV peripherals*	Not included	Not included	Not included	Not included
Total (in units_	384,000,000	310,000,000	73,700,000	19%

Source: electronicstakeback.com and the EPA

Why do Counterfeit Semiconductors exist?

- And the percentage of electronic devices being recycled is increasing.

E-Waste Generation and Recycling 2000-2011



Source: electronicstakeback.com and the EPA

Where do Counterfeit Semiconductors come from?



- And where is all the e-Waste going?
- Mostly to China (and a few other Asian countries)...



Where do Counterfeit Semiconductors come from?



- Where there is a huge industry stripping out the parts...



Where do Counterfeit Semiconductors come from?



- Remarking and refurbishing the parts...



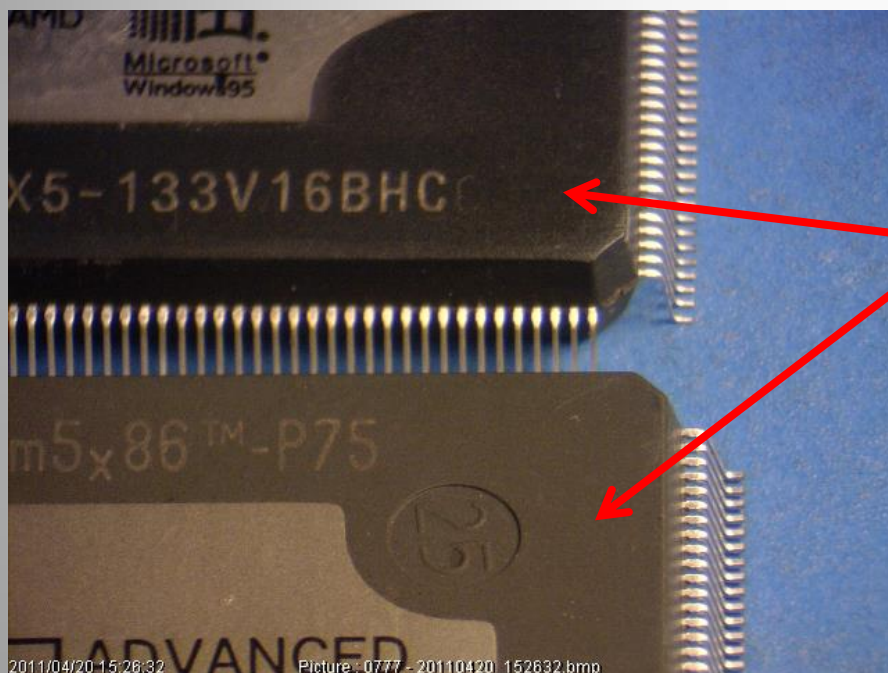
- And offering them for sale in open bazaars.



The Counterfeit Problem – Some Examples



- Advanced Micro Devices / P/N AM486DX5-133V16BHC

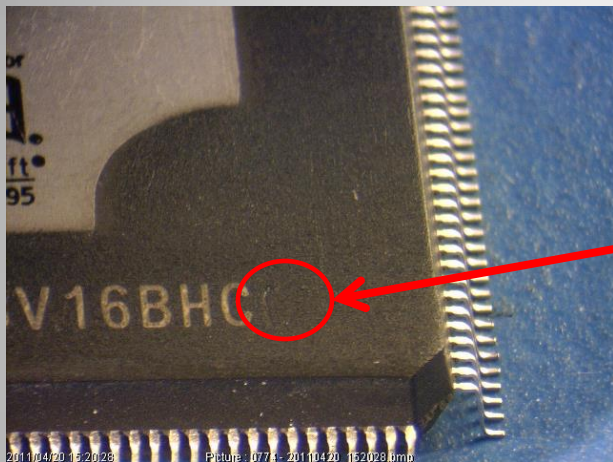


Note color difference between two
samples with the same date code

The Counterfeit Problem – Some Examples



- Advanced Micro Devices / P/N AM486DX5-133V16BHC



Ghost Marking

Dimple is flush with package

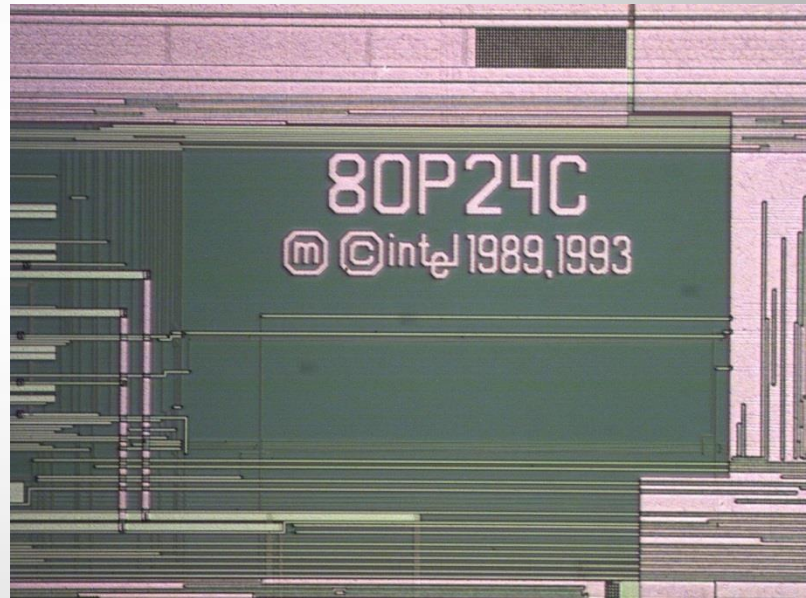


The Counterfeit Problem – Some Examples



Intel Logo inside an AMD Package

Fake! ... Real! ... NO Fake!



Identified as a Fake by parametric testing

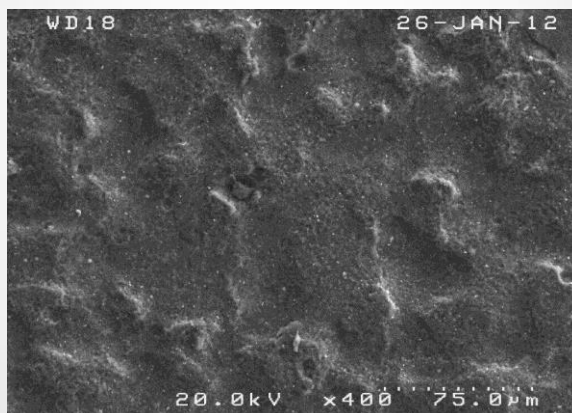
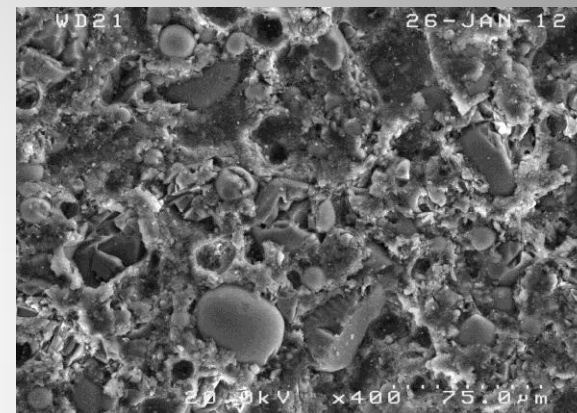
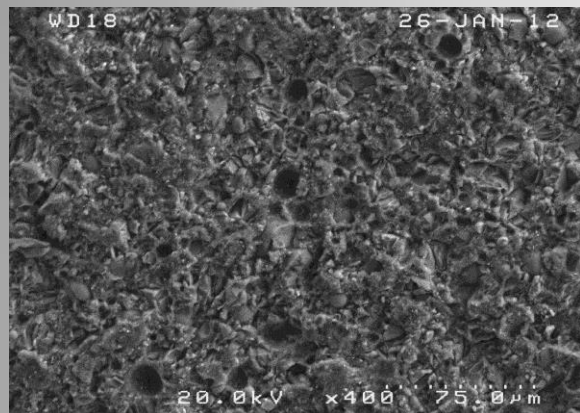
The Counterfeit Problem – Some Examples

- Newer threats - conventional visual techniques no longer adequate.
- New counterfeit threats that are non-recognizable by conventional visual detection techniques.
- Almost perfected micro-blast process
- Conventional visual techniques may not work, however SEM examination with known good samples can detect top surface variations.

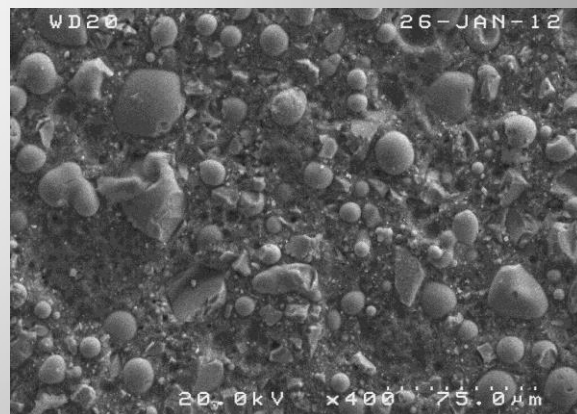
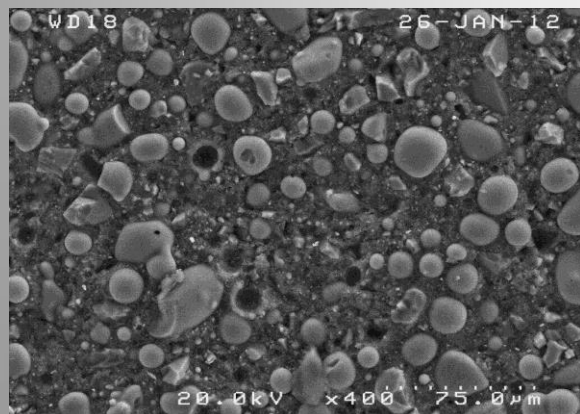
The Counterfeit Problem – Some Examples



SEM Analysis PLCC Micro-blasted Device



Ref (Known Good)



The Counterfeit Problem – Some Examples

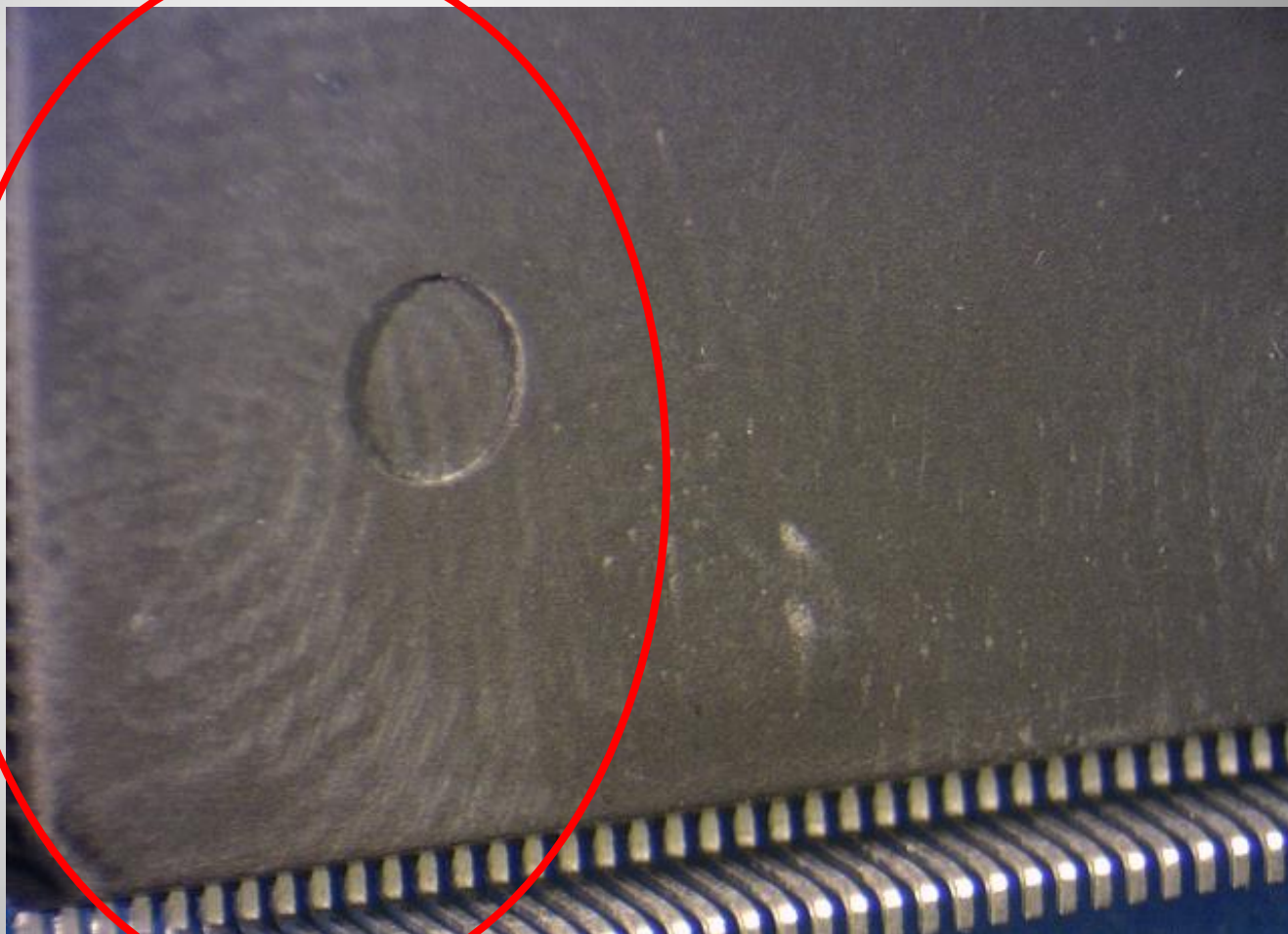
Some would say that with all the attention to the new laws and people going to jail that the counterfeiters would be getting smarter and being more careful.

I am not sure that is true in all cases as the following example shows.....

The Counterfeit Problem – Some Examples

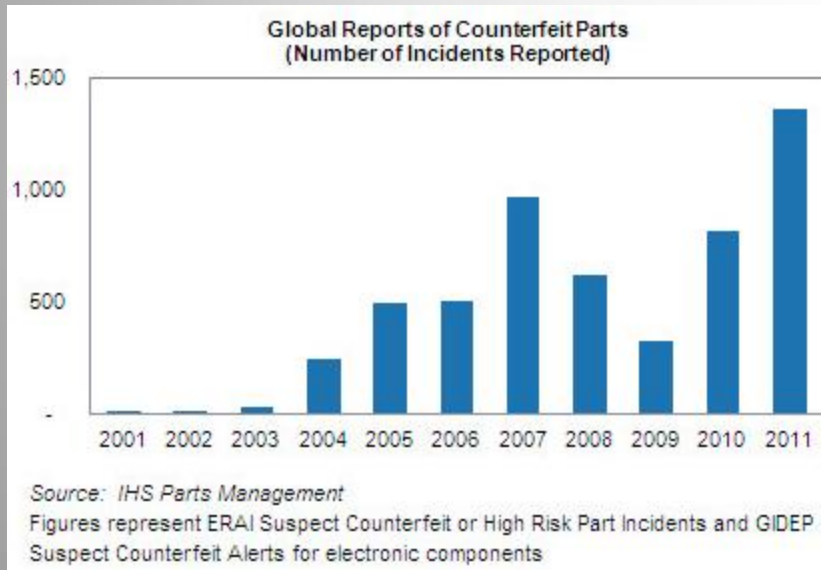


**This
counterfeiter left
his/her
fingerprint on
the part!!**



How big is the counterfeit semiconductor problem?

- Accurate figures are very difficult to come by, most figures are in the billions of dollars.
 - More than 12 million parts have been involved in counterfeit incidents during the period spanning the start of 2007 through April 2012 (IHS iSuppli and ERAI)



Top-5 Most Counterfeited Semiconductors in 2011
(Percentage of Counterfeit Part Reports)

Rank	Commodity Type	% of Reported Incidents
1	Analog IC	25.2%
2	Microprocessor IC	13.4%
3	Memory IC	13.1%
4	Programmable Logic IC	8.3%
5	Transistor	7.6%

Source: IHS Parts Management 2012

- And there is no sign the counterfeiters are giving up.

What role is the government playing?

- In 2012, Section 818 was added to the National Defense Authorization Act (NDAA). Section 818 provides guidelines to the DOD to keep counterfeit parts out of the supply chain. Section 818 states (in part):
 - Requires the Department of Defense ("DoD") to issue regulations regarding the definition, prevention, detection and reporting of actual or suspected counterfeit parts in the defense procurement supply chain.
 - Requires the Department of Homeland Security ("DHS") to create a "risk-based methodology" to enhance targeting of counterfeit electronics parts imported into the United States.
 - Mandates that DoD hold contractors responsible for detecting and avoiding counterfeit electronic parts, require contractors to use trusted suppliers, and require contractors to report counterfeit or suspect counterfeit parts that have entered the supply chain.
 - Requires that DoD revise the rules to make unallowable the costs of counterfeit and suspect counterfeit electronic parts, as well as the costs of any rework or corrective action necessary as a result of the use of counterfeit or suspect counterfeit parts.
- This last item states that if you are a contractor and have an issue concerning counterfeit parts, the entire cost to deal with the incident is the contractors responsibility! Thus the defense industry taking counterfeit parts much more seriously.

What role is the government playing?

Real enforcement is starting to occur - some examples:

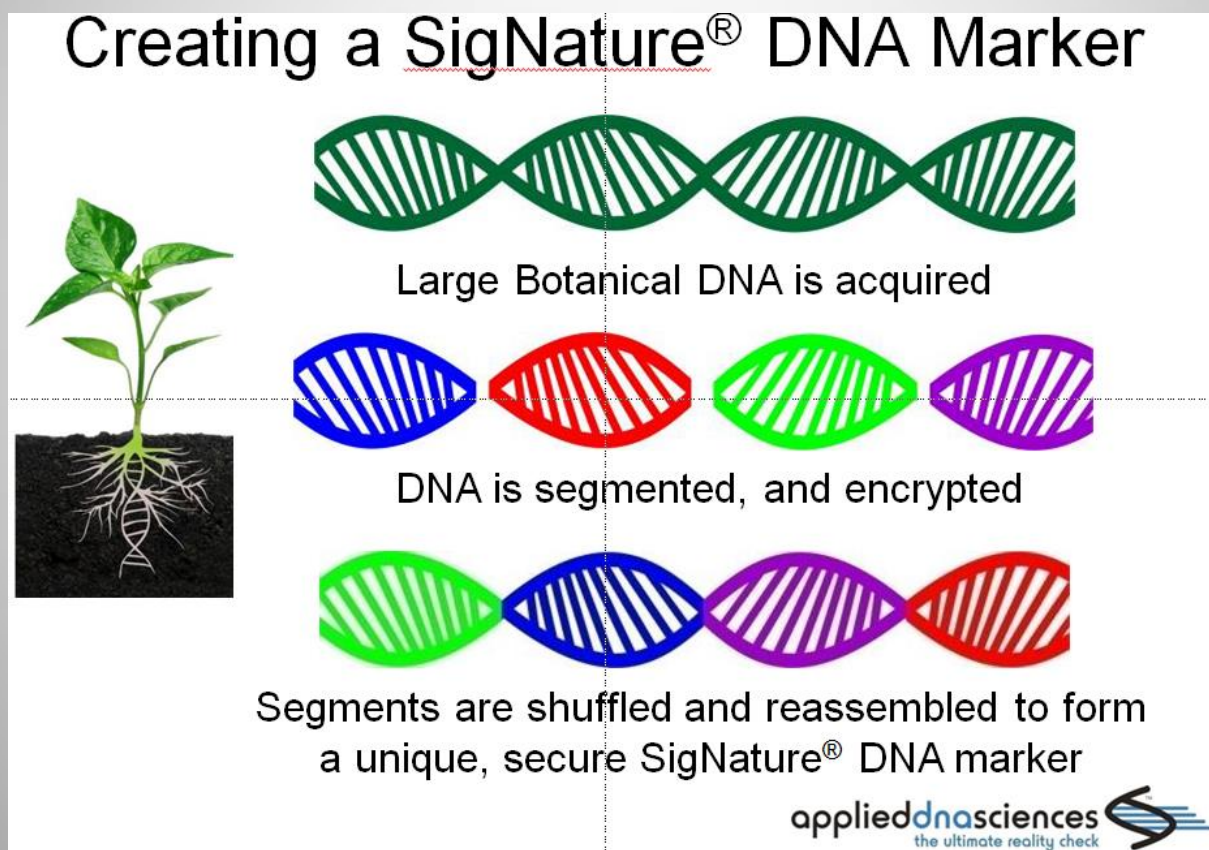
- “Business Owner Sentenced for Sale of Counterfeit Integrated Circuits to the U.S. Government – “On February 15, 2012, Mustafa Abdul Aljaff, 32, a business owner from Newport Coast, California, was sentenced to 30 months in prison....”
- “The US Air Force suspended Hong Dark Electronic Trade Company and its subsidiaries from government programs for allegedly selling tens of thousands of counterfeits to key defense contractors.....”
- “Stephanie A. McCloskey, 39, of Clearwater, Fla., was sentenced today to 38 months in prison for her role in a scheme in which she and others imported counterfeit integrated circuits from China and Hong Kong....”

And there are many more.

What role is the government playing?



Defense Logistics Agency (DLA) is promoting the use of DNA ink marking from Applied DNA Sciences.



What role are the standards agencies playing?

SAE G-19 Aerospace Standards

Standard	Title	Status
SAE AS5553 Rev A	Counterfeit Electronic Parts; Avoidance, Detection, Mitigation, and Disposition	- Released in Feb. 2013 - Under revision by G-19CI Committee to AS5553B ➤ To be aligned with other G-19 Standards
SAE AS6081	Counterfeit Electronic Parts Avoidance – Distributors	Released in Nov. 2012 – Rev A under Development
SAE AS6171	Test Methods Standard; Counterfeit Electronic Parts	Release expected in 4Q2013 / 1Q2014
SAE ARP6178	Counterfeit Electronic Parts; Tool for Risk Assessment of Distributors	Published in Dec 2011
SAE AS6462	AS5553 Verification Criteria	Published in Nov 2012
SAE AS6174	Counterfeit Materiel; Assuring Acquisition of Authentic and Conforming Materiel	Published in May 2012
SAE ARP6178	Fraudulent/Counterfeit Electronic Parts; Tool for Risk Assessment of Distributors	Published in Dec 2011
SAE AIR6273	Terms and Definitions – Fraudulent/Counterfeit Electronic Parts	WIP
SAE AS6496	Fraudulent/Counterfeit Electronic Parts: Avoidance, Detection, Mitigation, and Disposition - Authorized/Franchised Distribution	WIP
SAE AS6301 AS6081	Fraudulent/Counterfeit Electronic Parts: Avoidance, Detection, Mitigation, and Disposition - Distributors Verification Criteria (WIP)	WIP

What role are the standards agencies playing?

Summary of other documents (there are more)

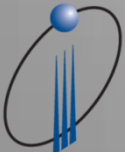
Item	Title	Status
IDEA-1010	Methods to detect counterfeit devices - Great color photos and guidance In a major update (Rev B out 6-2011)	Issued and available at http://www.idofea.org/products
IEC/TS 62668-1:2012(E)	Requirements for avoiding the use of counterfeit, recycled and fraudulent components used in the aerospace, Defense and high performance (ADHP) industries	- Available at http://webstore.iec.ch/webstore/webstore.nsf/Artnum_PK/46350 - Group is working on TS62668-2 designed for non-franchised distributors
G-12 Counterfeit Mitigation Committee	Reports works done by various committees SAE activities	Is now part of SAE
TechAmerica/ANSI STD-0016	Defines the requirements for developing a DMSMS Management Plan for minimizing the cost and impact of obsolete parts and material	Published in Dec 2011
AIA	Various Initiatives to promote AS5553, AS6081, TechAmerica STD-0016	Promotion On-Going
CCAP-101	Methods to detect counterfeit devices Great color photos and guidance In a major update (Rev B out 6-2011)	http://www.cti-us.com/pdf/CCAP101Certification.pdf
UK MoD Counterfeit Avoidance Working Group	Developing policy and guidance for counterfeit mitigation	At working group level with Industry and UK Defense suppliers participating
Aerospace Counterfeit Mitigation	Aerospace Counterfeit Mitigation Document	Status unknown

What can be done to eliminate counterfeit parts?

Increasing Cost/Risk



1. Buy parts from the original manufacturer or authorized distributor whenever possible (Xilinx, Avnet, Arrow).
2. Buy parts from authorized after market manufacturers (Traditionally companies like Rochester and Lansdale, but increasingly companies like Avnet and Arrow).
3. Buy parts from known sources with original paperwork traceable to the original manufacturer (another OEM that bought parts from a franchised source and has the original paperwork).
4. Do last time buys when parts become obsolete (can be expensive and hard to estimate exactly how many will be needed).
5. Qualify alternative suppliers which may not yet be obsolete (when market demand decreases usually all suppliers get out of the market).
6. Use FPGA's/ASICs to emulate obsolete devices (expensive, requires board re-layout at a minimum).
7. Redesign systems to use non-obsolete parts (most expensive option).
8. Buy parts from a reputable non-franchised broker (risk based testing and evaluation is necessary).
9. Buy parts from a questionable broker (must do full electrical test and possibly qualification).



What can be done to eliminate counterfeit parts?

Famous Mark Marshall **Risk Mitigation Matrix**

		Detection Methods								
			External Visual & Phys Dim	XRF Analysis	Mark Perm	Internal Visual	Basic DC Test	Min Func Test 25C	Full Spec Extended Temps	Test & Qual
Counterfeit Type	Non Functioning Devices	No Die	Possible	No	Possible	Yes	Yes	Yes	Yes	Yes
		Wrong Die Re-Marked	Possible	No	Possible	Likely	Yes	Yes	Yes	Yes
		Board Pulls	Possible	No	No	No	Possible	Likely	Yes	Yes
	Functioning Devices	Failed Real Parts	No	No	No	No	Possible	Likely	Yes	Yes
		Speed up-marking	Possible	No	Possible	No	No	Possible	Yes	Yes
		Spec up-marking	Possible	No	Possible	No	No	Possible	Yes	Yes
		Temp up-range	Possible	No	Possible	No	No	No	Yes	Yes
		Pb Free Re-marked	Possible	Yes	Possible	No	No	No	No	No
		Lesser part (Knock-off)	Possible	No	Possible	Possible	Possible	Possible	Likely	Yes

What can be done to eliminate counterfeit parts?

As counterfeiters become more sophisticated, full AC/DC/Functional electrical test is quickly becoming essential.

		Detection Methods								
			External Visual & Phys Dim	XRF Analysis	Mark Perm	Internal Visual	Basic DC Test	Min Func Test 25C	Full Spec Extended Temps	Test & Qual
Counterfeit Type	Non Functioning Devices	No Die	Possible	No	Possible	Yes	Yes	Yes	Yes	Yes
		Wrong Die Re-Marked	Possible	No	Possible	Likely	Yes	Yes	Yes	Yes
		Board Pulls	Possible	No	No	No	Possible	Likely	Yes	Yes
	Functioning Devices	Failed Real Parts	No	No	No	No	Possible	Likely	Yes	Yes
		Speed up-marking	Possible	No	Possible	No	No	Possible	Yes	Yes
		Spec up-marking	Possible	No	Possible	No	No	Possible	Yes	Yes
		Temp up-range	Possible	No	Possible	No	No	No	Yes	Yes
		Pb Free Re-marked	Possible	Yes	Possible	No	No	No	No	No
		Lesser part (Knock-off)	Possible	No	Possible	Possible	Possible	Possible	Likely	Yes

Summary

- Counterfeit semiconductors are proliferating because of obsolescence and Asian recycling of e-Waste.
- The problem is large and will get bigger and more sophisticated.
- The US Government is stepping in and beginning to require supply chain integrity.
- The total cost of counterfeit intrusion into a product or system will be borne by the contractor supplying that product or system.
- Consequently, substantial supply chain risk analysis is occurring and new standards are being developed.
- Don't buy questionable parts if it can be avoided.
- If it can't, apply the appropriate risk mitigation techniques including full AC/DC/Functional testing.

Integra's Employee Owner's Thank You!



- **Semiconductor Test Facilities in Wichita Kansas and now Albuquerque, NM**
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- **30 Year History as a Value Added Semiconductor Test Service Provider**
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