



*Insight Analytical Labs*

# Contrasting Quality Inspections and Engineering Inspection for Counterfeit Detection

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# Outline

- **Introduction and Motivation**
  - **Dynamic Nature of challenge**
- **Inspection Methods**
  - **Quality Inspection**
  - **Engineering Inspection**
  - **Examples**
- **Resources**
- **Future Expectations**
- **Summary**

# Introduction

- Electronic products are all around us in our homes, our work, as well as in transportation, medical, entertainment, and communication equipment. Perhaps even inside us!
- Failure Analysts inspect components for quality and reliability every day. They can be well suited to inspect for suspect counterfeit issues.
- As an industry, we have overcome quality and reliability issues before and we will again.
  - *Need continued focus on awareness and continuous improvement*
  - ***If there is one thing I leave you with today. It is the expertise that failure analysts bring to this issue.***

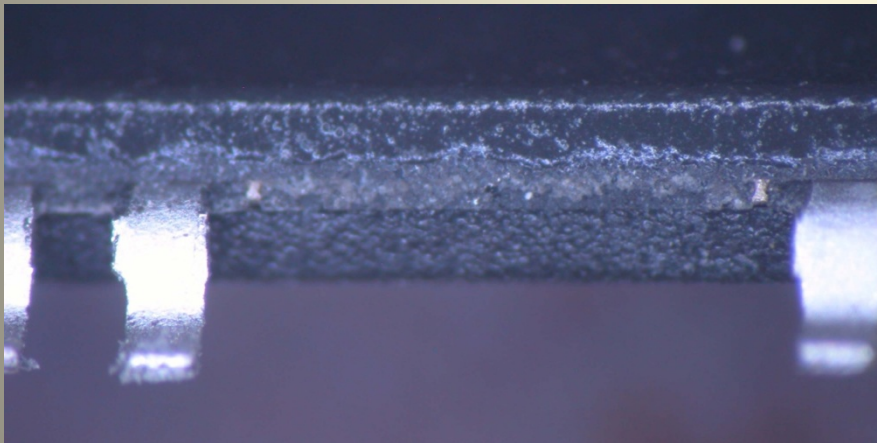
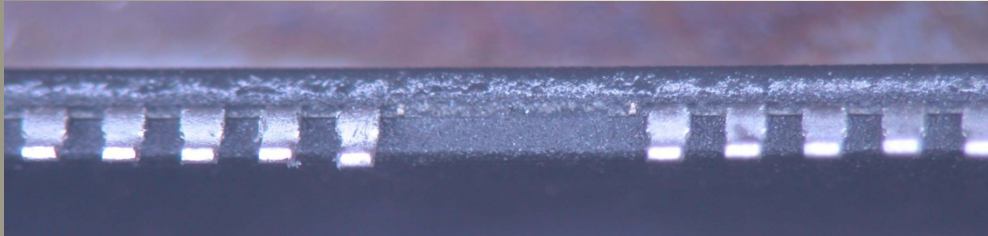
# Background:

- Early counterfeiting
  - Blacktopping
  - Competitor part (pin compatible)
  - Upgrade: Mil-Spec, Temp, Speed, Reliability
  - Re-cycled part (removed from PCB)
  - Re-worked to meet RoHS (or just remarked)

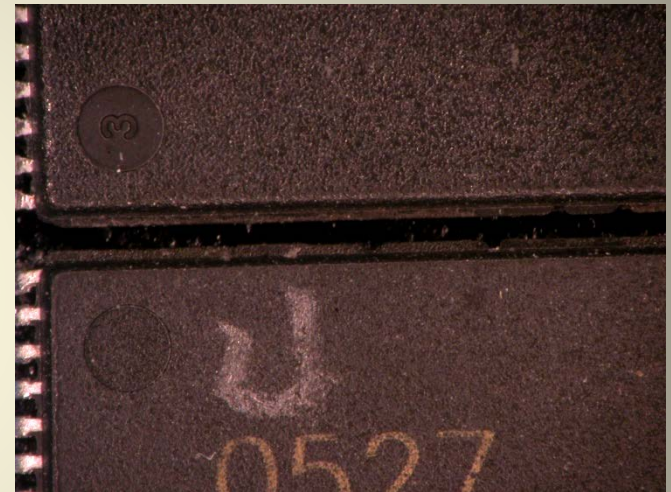
However, *The challenge is dynamic*

# Change of date code

- 2 different Samples with blacktopping



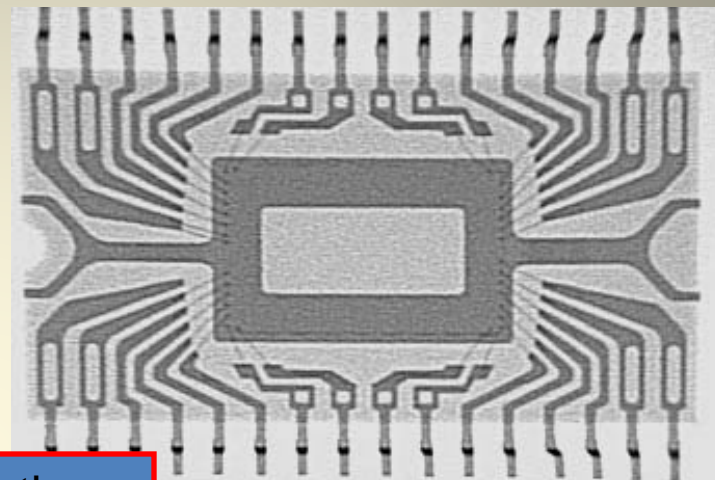
**Sample-1**



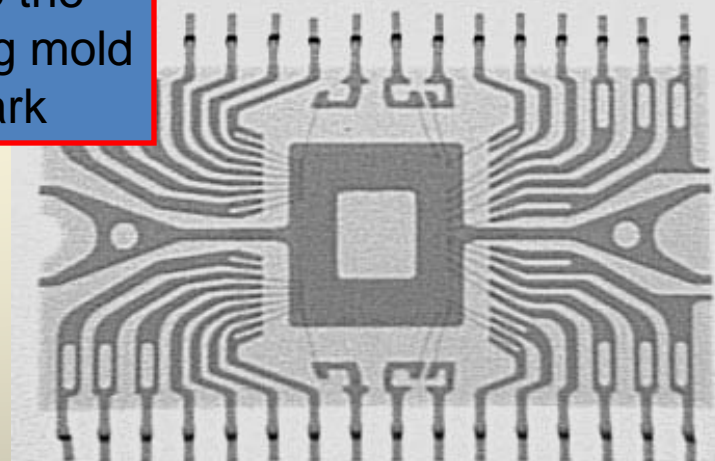
**Sample-2**

***Top surface has been repainted. Detected in side view on one device, by comparing top to bottom on another (texture).***

# Incorrect part



Note the missing mold mark



***By today's standards, these are easy to detect.***

# More recent challenges:

- Present and coming challenges
  - Everyday the diversity and quantity of end of life components increases resulting in more oddities.
  - Wider range of components (passives, batteries, MEMS)
  - Counterfeiting groups get better informed, equipped and mature.
    - **Improved resurfacing before remarking**
    - **Improved refurbishing**
    - **Mature operations with trained operators**
  - Counterfeits are being identified in field returns.

# Quality Inspections

- Quality Inspections follow standards, for example:
  - IDEA 1010A
  - IDEA 1010B
    - **Now includes package decapsulation**
      - **Die manufacturer marks & logos**
      - **Process Technology**
      - **Die function (Memory, Logic, Analog, etc.)**
  - SAE 5553A
  - CCAP 101



# Quality Inspections

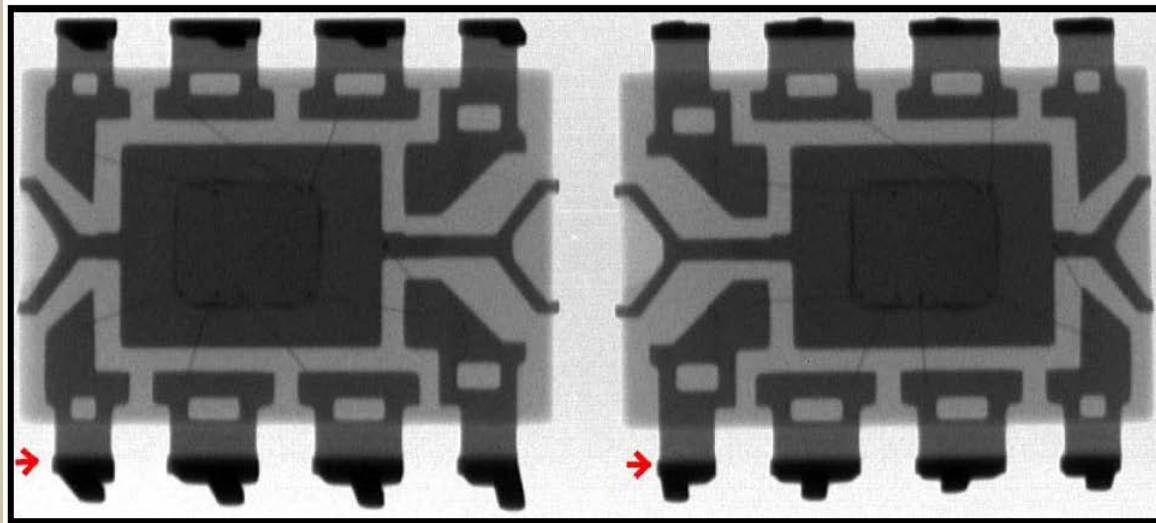
- Each of the standards provides excellent checks for known issues.
- Since they are based on known issues, they are not as well suited for emerging concerns or situations that don't fit previous experience.
  - New blacktopping methods
  - Parts from same vendor, multiple sites
  - Wide variety of components (discretes, passives, MEMS, multi-chip in package, new package styles, etc.)
  - Quality escapes
    - **Can be falsely identified as suspect counterfeits.**

# Engineering Inspections

- Goes above and beyond Quality Inspections
  - Comparison to industry norms
  - Comparison to historical database (over 2000 entries)
  - Identify and Resolve oddities
  - Identify and Setup additional testing as required.
- What engineers are involved:
  - Quality & Reliability Engineers
  - Test & Product Engineers
  - Failure Analysis Engineers

# Analysis Takes Experience

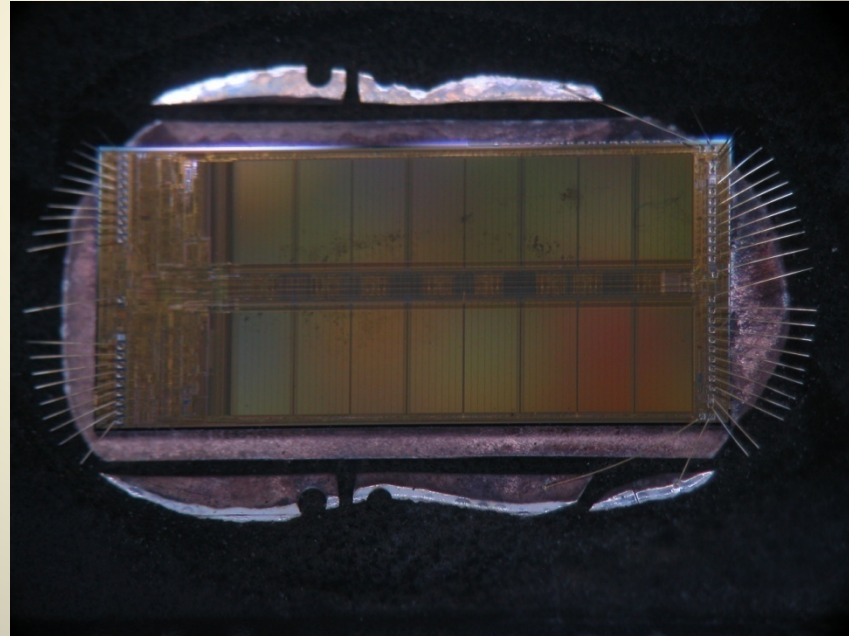
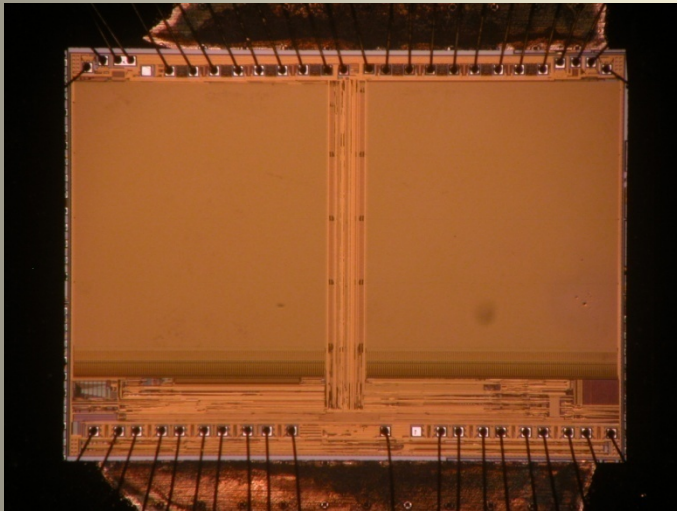
- Some situations demand more than an exemplar part.
- For example: Two identical packages, but interior is a mirror image.



- Part would be fully functional and meet quality standards. But it would not match an exemplar part.
- Resolution required contact with packaging experts (engineers) to confirm standard packaging conditions.

# Incorrect part in “same lot”

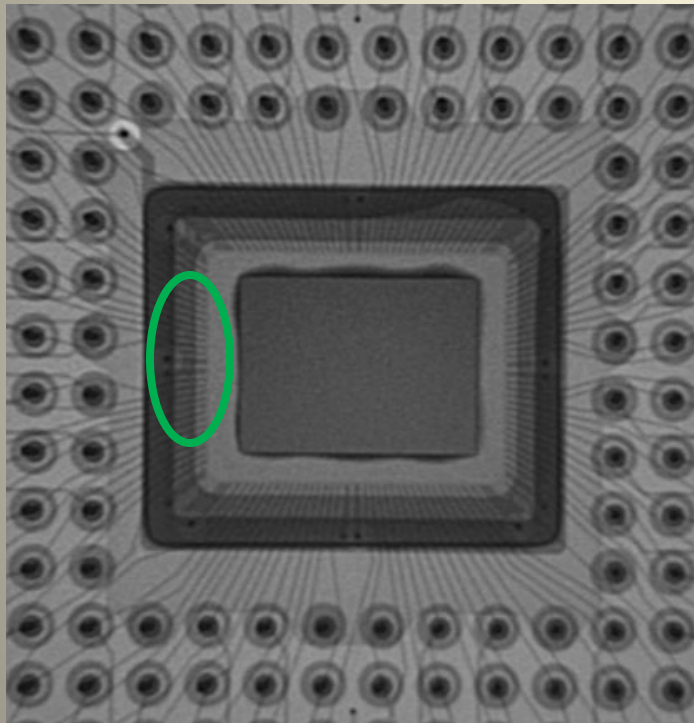
- Example: Part can be detected by standard Quality Inspection
  - Intel memory with same P/N and date code.



*Customer requested decapsulation after X-ray showed the two devices did not match.*

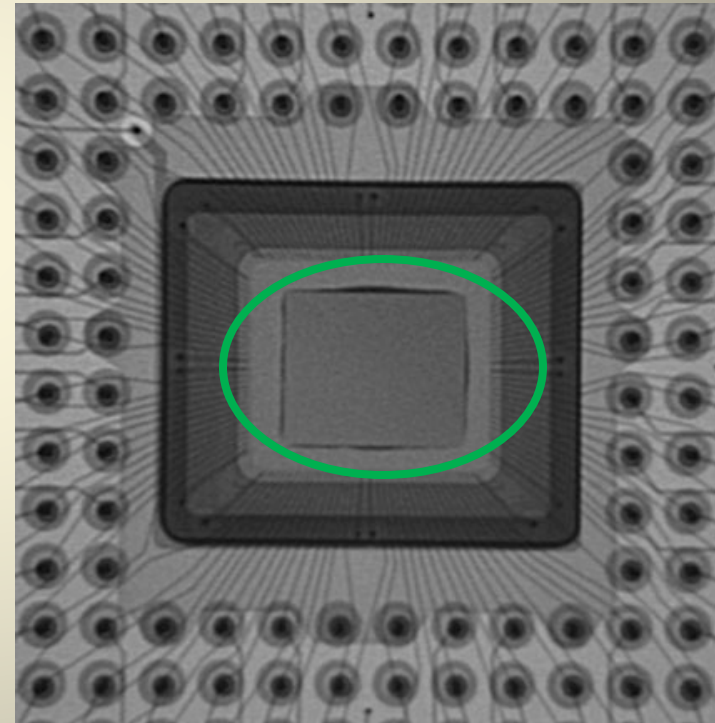
# Die size alone can be deceiving

- Example: Part difficult to detect accurately by standard Quality Inspection
- Same product with a “Die Shrink”. Exemplar part is not very useful.



XC3064-70PG132I  
Older datecode

← SAME →

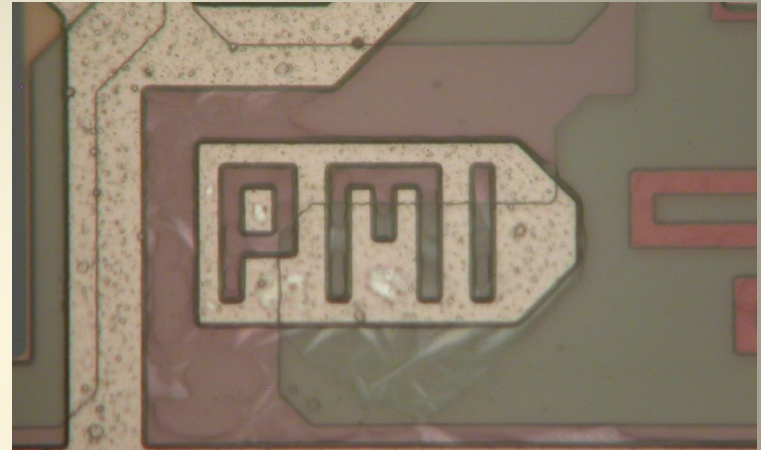
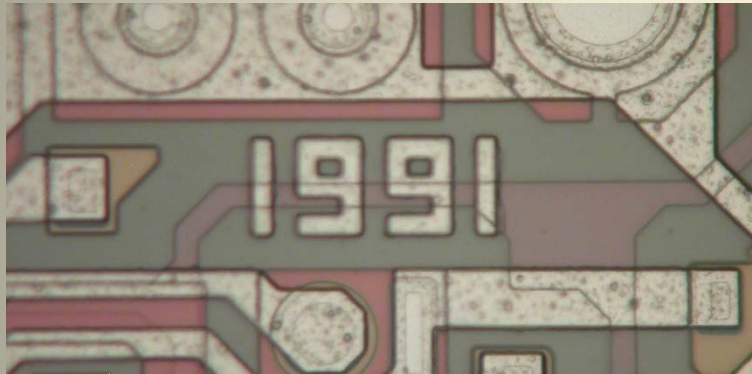


XC3064-70PG132I  
Newer datecode

# Analysis Takes Experience

Missing or mis-matched manufacturer.

- Parts appear counterfeit, but are not:
  - PMI = Analog Devices



- Analog IC produced in the PMI fab acquired by Analog.
- Despite the date, this was a recent example.



*Decision required knowledge of company history.*

# More Examples of Acquisitions

Internal mark does not match the package marking.

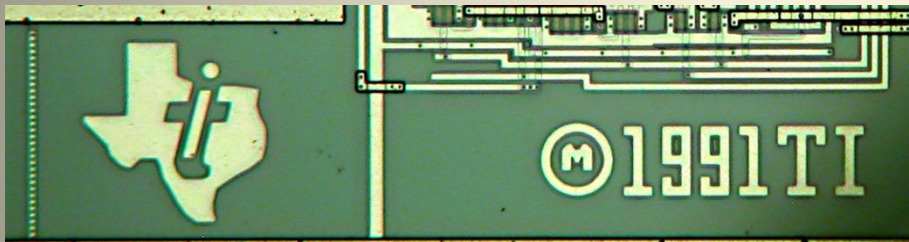
- Analog Devices purchased PMI
- Intel and AMD cross-licensing
- Intel acquisition of Level1
- Texas Instruments acquisition of Burr-Brown and National
- Conexant acquisition of Brooktree
- Motorola purchase of Cherry Semiconductor
- Motorola spin-off of Freescale and ON Semiconductor
- Crystal acquired by Cirrus Logic
- Fairchild/Schlumberger/National mergers & acquisitions
- ETC., etc. etc.

# Example of Straight-forward Match

Texas Instruments and Cypress

Texas Instruments

TCM320AC36A



Cypress

7C1021A

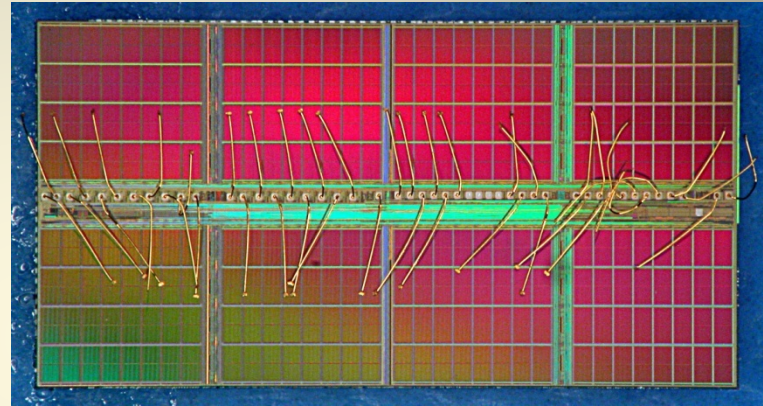
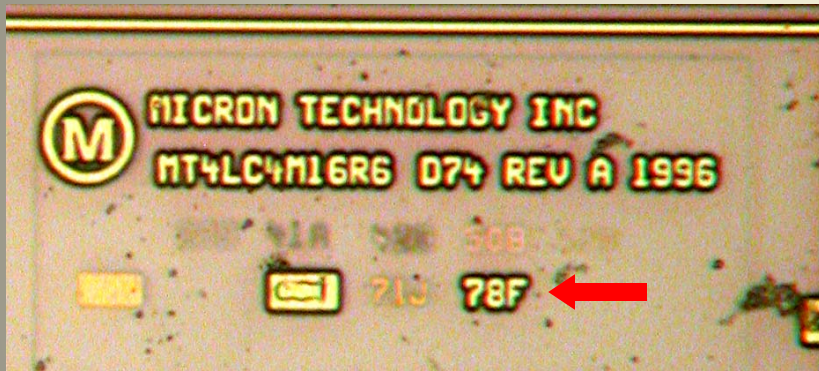


*Markings on die are rarely a perfect match.*



# Remarking example

- Micron memory with varying datecodes and revisions.



*All of these were marked with same product number and Revision level.*

# Die Markings

- Multiple revisions of same IC; however, company was purchased. Note the up-revision of each mask level.



***Failure Analysts have the tools to detect fraud and quality issues.***

# Resources

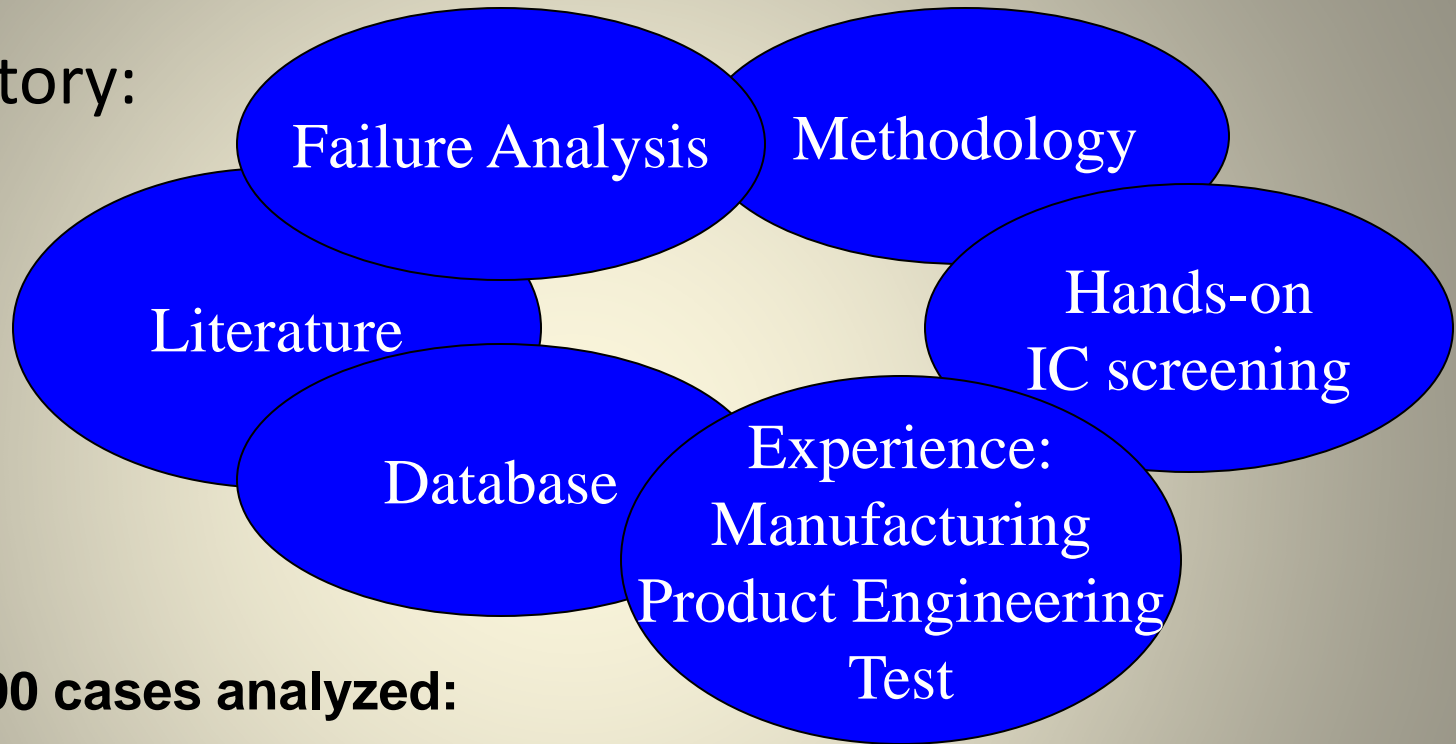
- Engineering expertise can be found in a variety of places (for example):
  - Failure Analysis Service Companies
  - Electronic Test Service Companies
  - Quality and Reliability Service Companies
  - Independent consultants
- What to look for:
  - Years of experience with products; inside and out
  - Familiarity with suppliers and variety of components
  - Experience with components back to 1980s.
  - Experience with Quality and Counterfeit Inspections.

# Engineering Approaches

- A Failure Analyst can apply knowledge of the industry, and components to analyze each suspect component:
  - Silicon ICs, and discretes
  - Optoelectronics
  - MEMS
  - GaAs
  - MLCC and other capacitors
- Suspect components are compared to analysts' experience and digital database of information.
- Components are understood from inside out.
  - From design through manufacture and test.

# Resources

- IAL history:



- **Over 2000 cases analyzed:**
- **Includes products: 1984-2013,**
  - **Silicon, GaAs**
  - **MEMS**
  - **Discretes, passives, Optoelectronics**

*Over 125 Man-years  
of experience*

# Where is the next Counterfeit Threat?

- New component types are being found that are also counterfeit (connectors, relays, and batteries, etc.).
- Expect refurbished parts to look “like new”.
- Continued pressure from part shortages due to supply chain issues.
- Strategies to detect counterfeits in one market may not work in another (geographic areas and market segments).

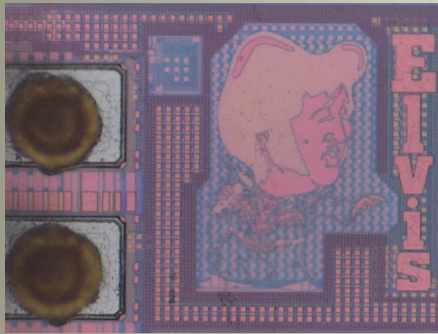
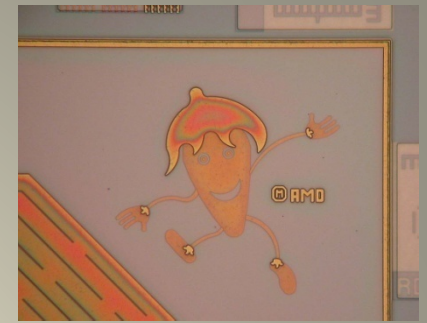
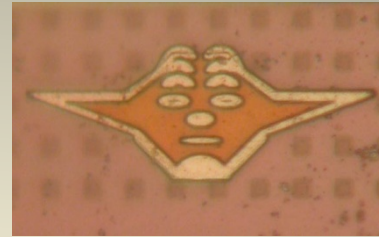
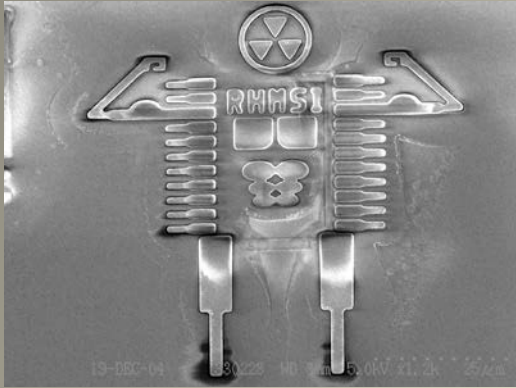
# Future, emerging

- Product Design for Anti-tampering
  - Built-in design features (like JTAG) to authenticate devices. (Some memory makers already doing this.)
  - manufacturer. (Analogous to VISA hologram.)
  - Enhanced ID tracking (especially for lot packaging)
  - Hard to copy logos and part marking to identify
  - Advanced DNA marking now required in some cases.
- Standards in industry
  - Tighter standards on part marking and documentation methods that support traceability.
  - Teaming of companies (data sharing) to reduce risk and cost of mitigation.

# Conclusions

- Counterfeits only escape detection for a limited time.
  - Our goal should be to reduce the time to detection
- Methods and resources exist to address this need.
  - Quality Inspections are a necessary first step.
  - Engineering inspections can reduce risk further:
    - When there is no Exemplar part
    - Part oddities and wider variety of components
    - Correctly identify quality issues and failures from field
    - Establish additional testing & inspection when required.
- The Electronics industry has faced similar challenges in the past and will rise to the challenge again.





# Questions?

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