

Reverse Engineering using X-Ray vIII

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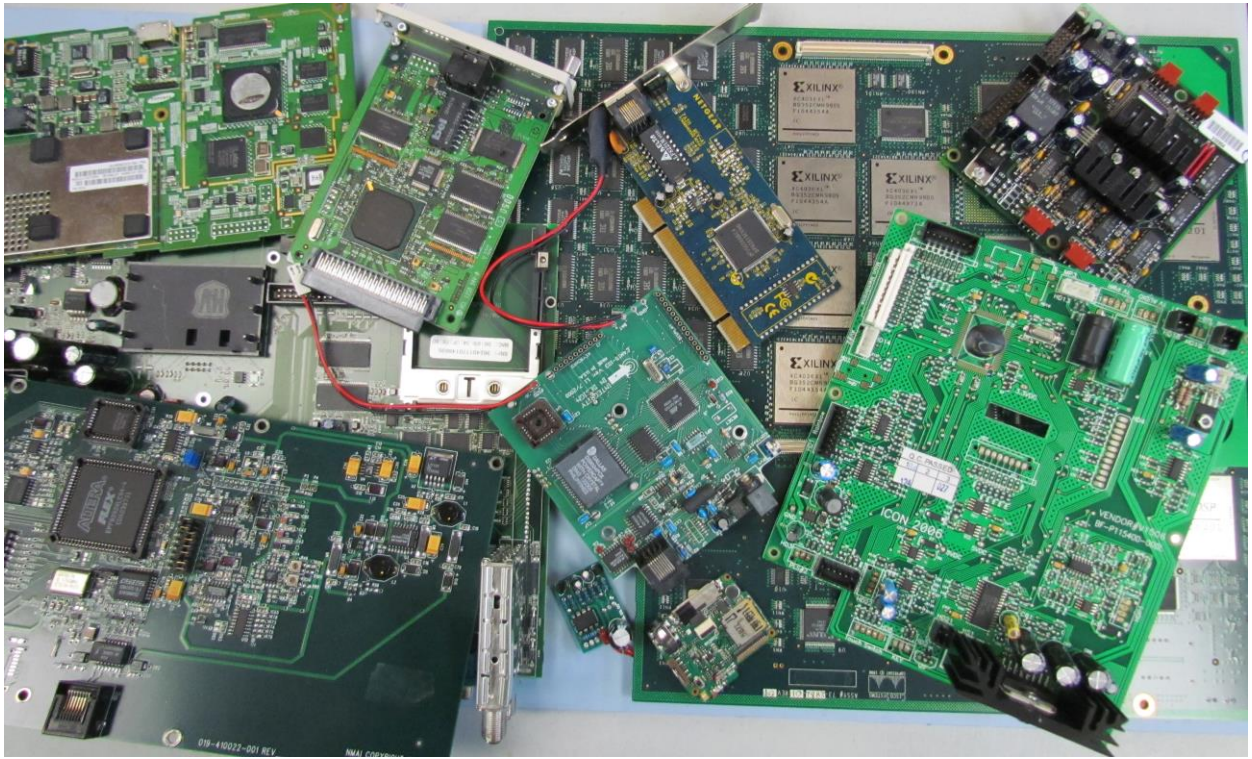
Circuit boards come in various shapes and sizes.



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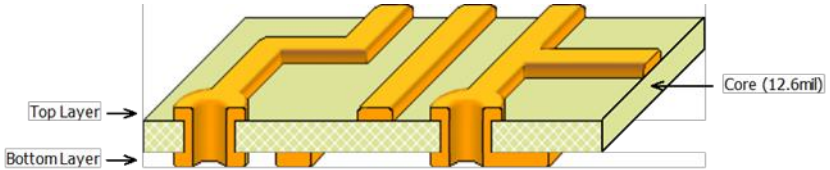
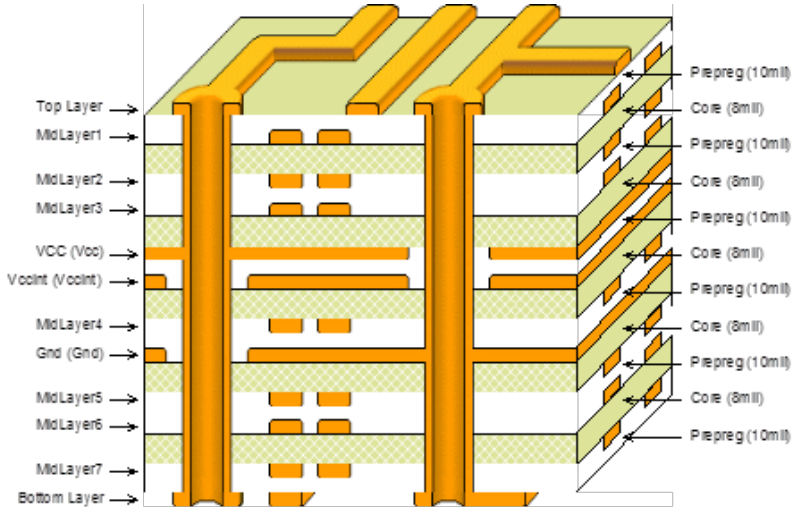
From PCBs outward appearances, the complexity is not evident. Below are cross sectional views of circuit boards illustrating the unseen differences.

Simple 2 layer design



Complex 12 layer



Both PCB's are the same thickness, the 12 layer is expanded to better illustrate the layer properties.

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Common methods used for reverse engineering circuit board designs:

- Back lighting, to aid visual circuit tracing mostly effective on:
  - ✓ Single sided--mask or component placement can obscure view
  - ✓ Double sided
  - ✓ Few multilayer boards--multilayer boards without plane layers
- Conductive tracing, using a method such as an Ohm meter:
  - ✓ Effective on most single, double, and some multilayer boards
- Mechanical delayering:
  - ✓ Very destructive; ineffective on populated boards

These methods are virtually ineffective with most BGA designs.

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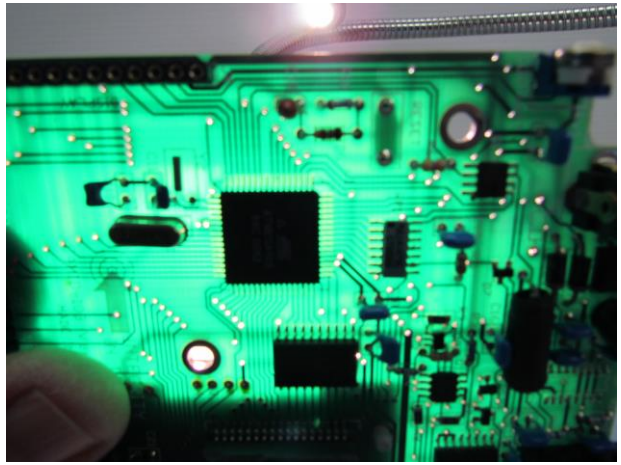
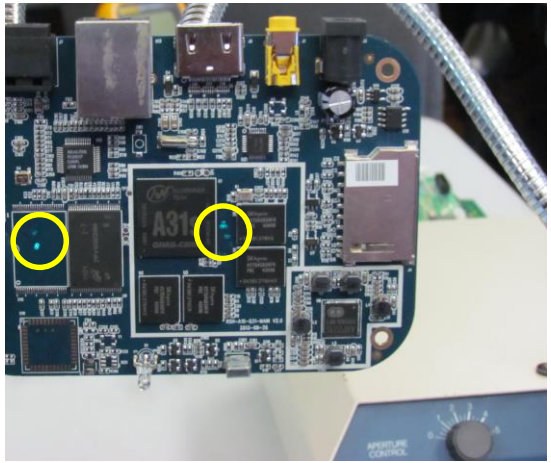
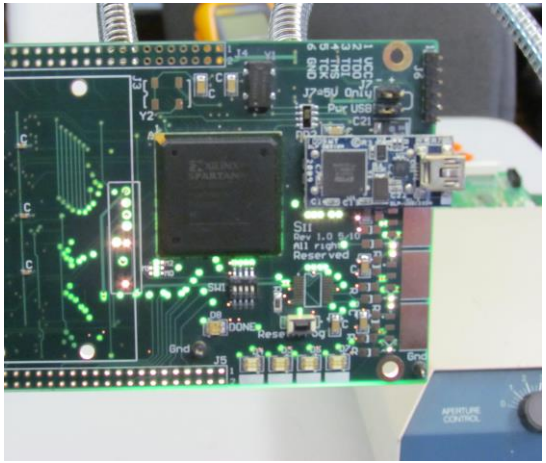
Back lighting aids in tracing double-sided board.







Back lighting is ineffective on multilayer with internal planes.

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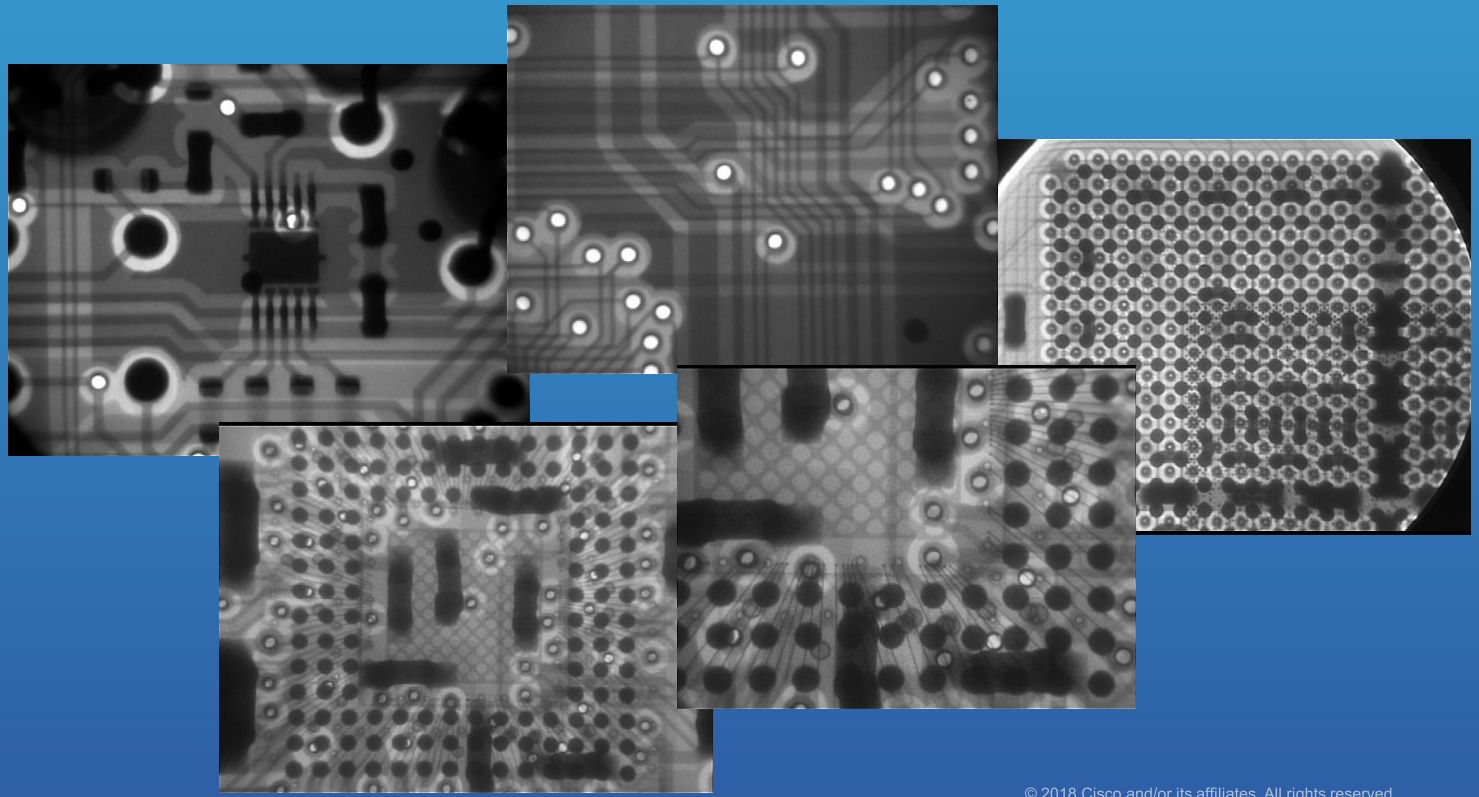
Using X-Ray everything can be revealed. Practically nothing can be hidden for view.



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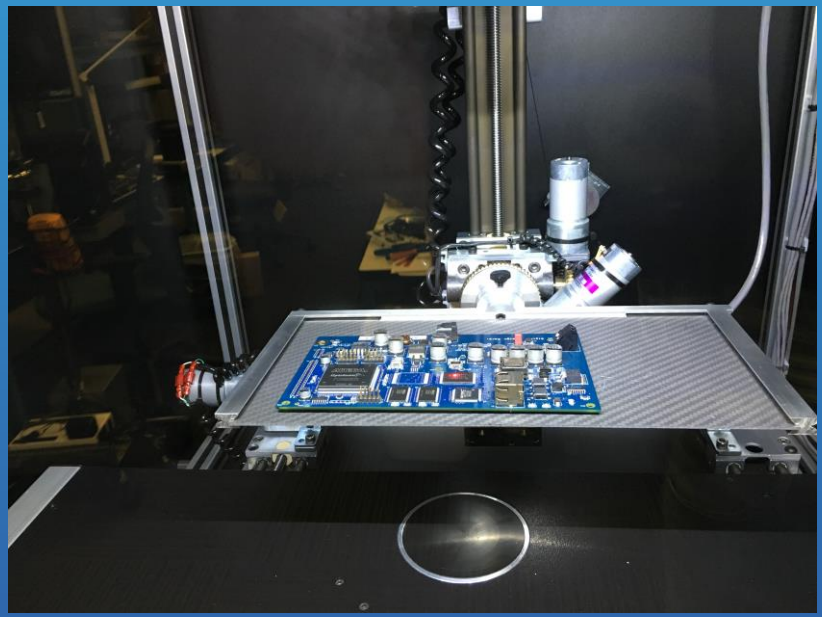
Glenbrook Jewelbox 90T





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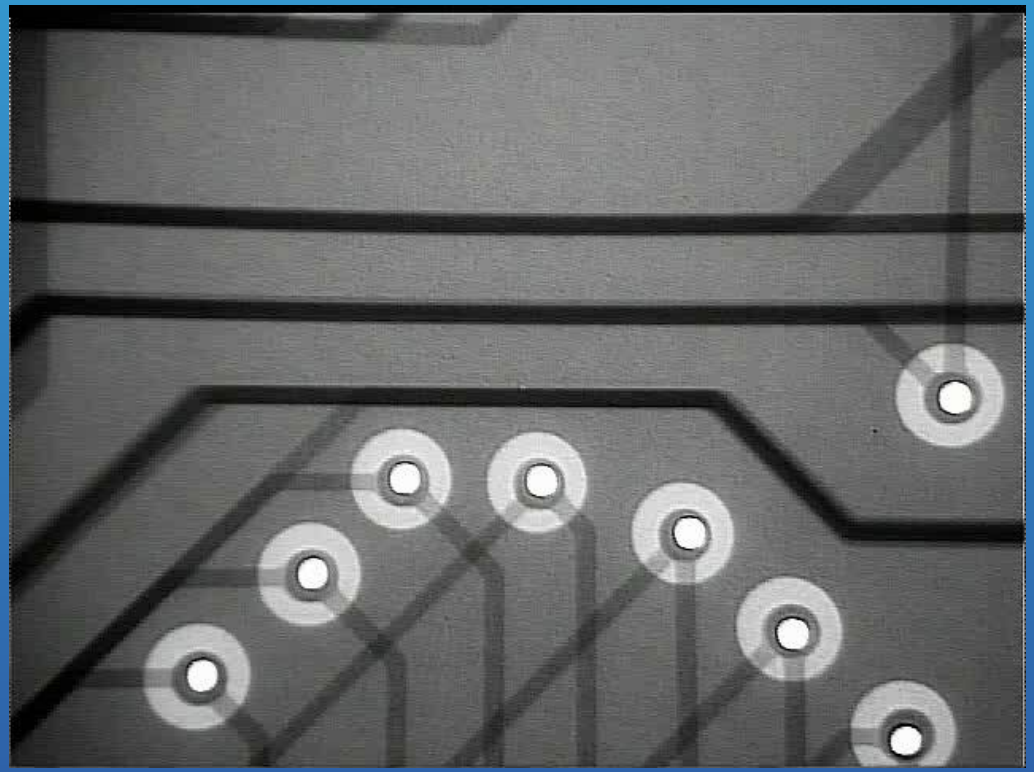
Angular view



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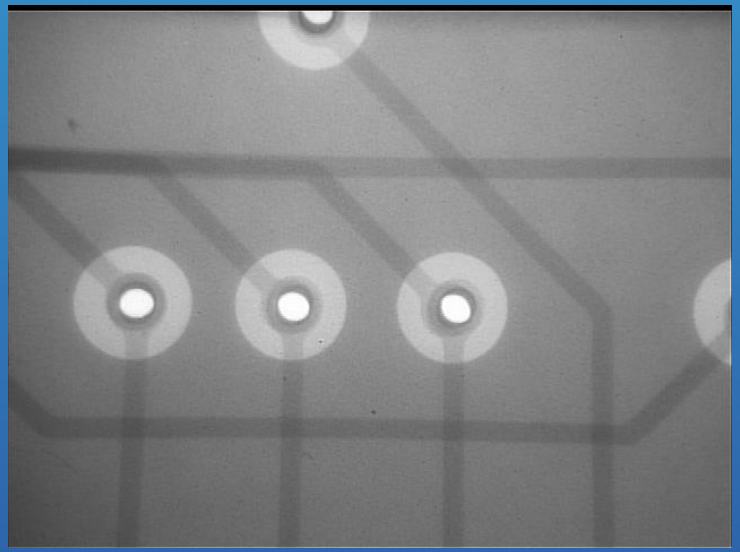
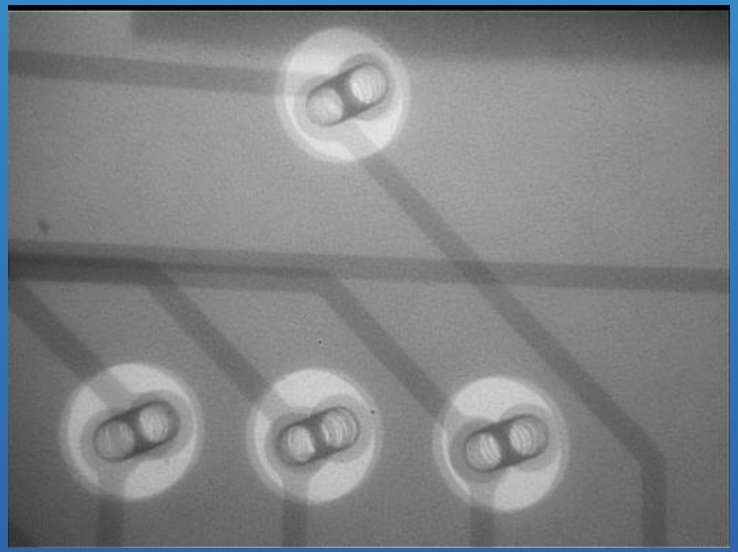
Angular view simplifies tracing multilayer circuitry.

Direct view



Angular view



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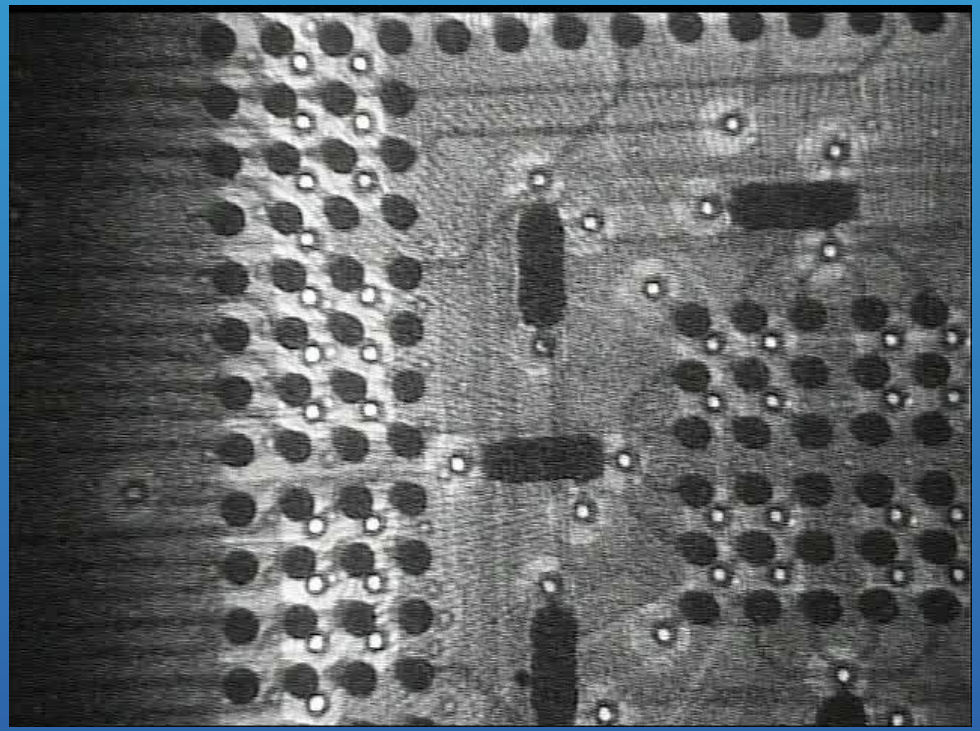
Zoom



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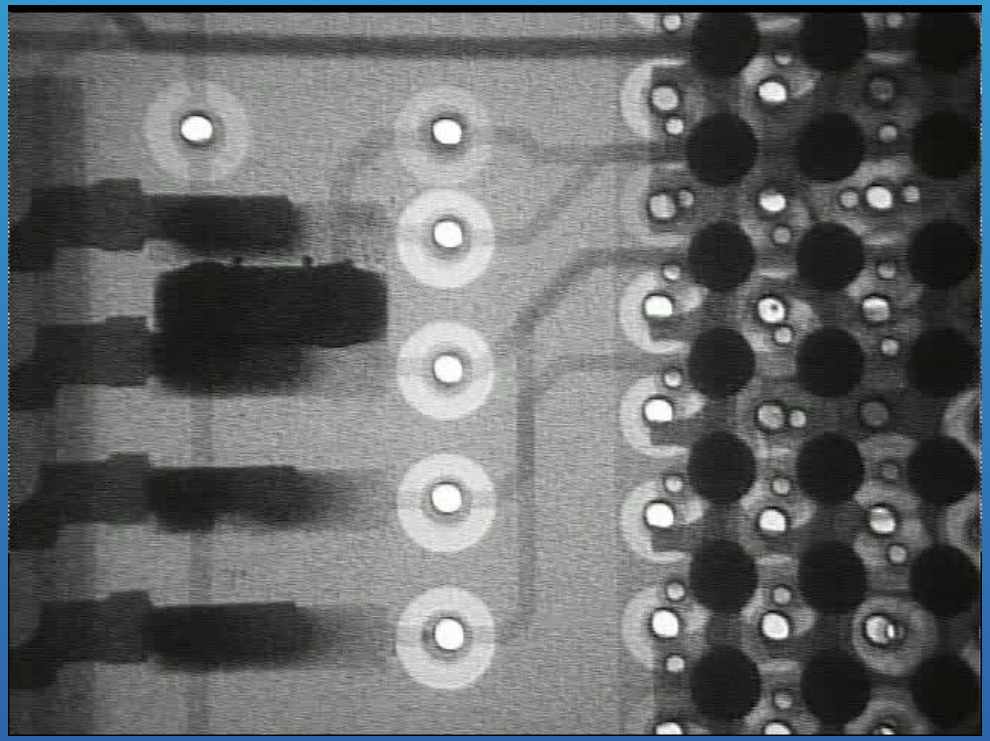
Zoom & Tilt



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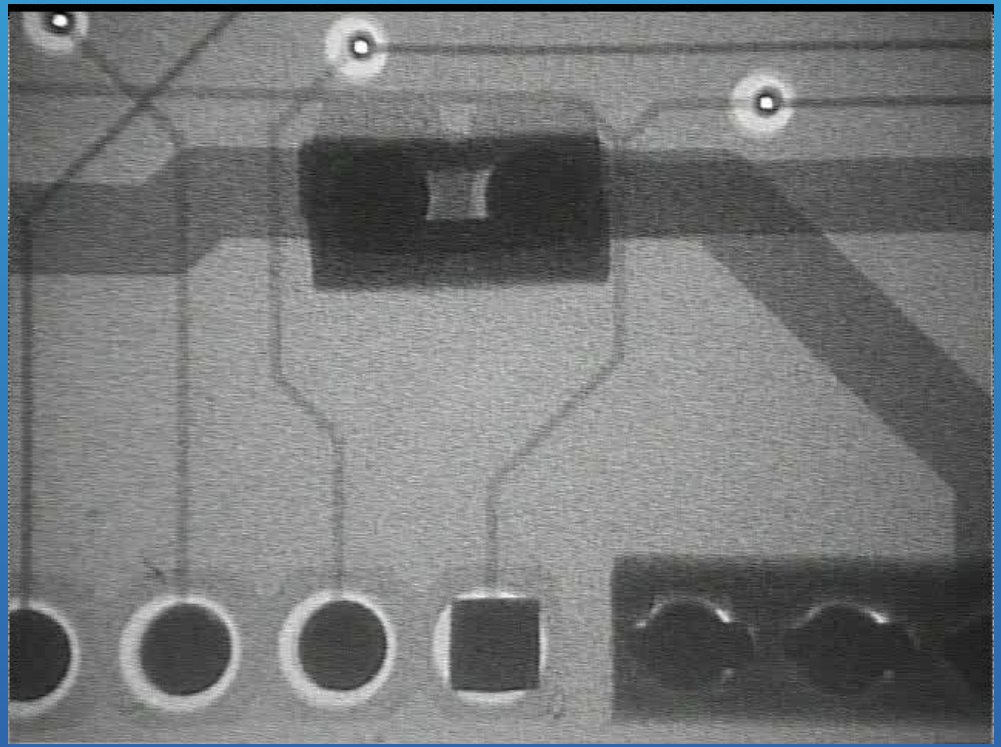
Trace



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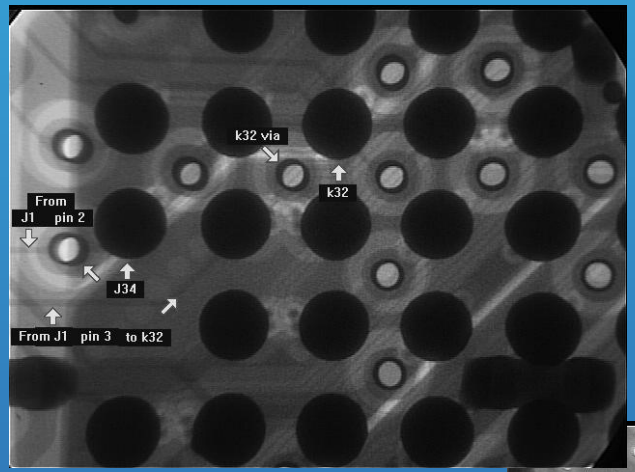
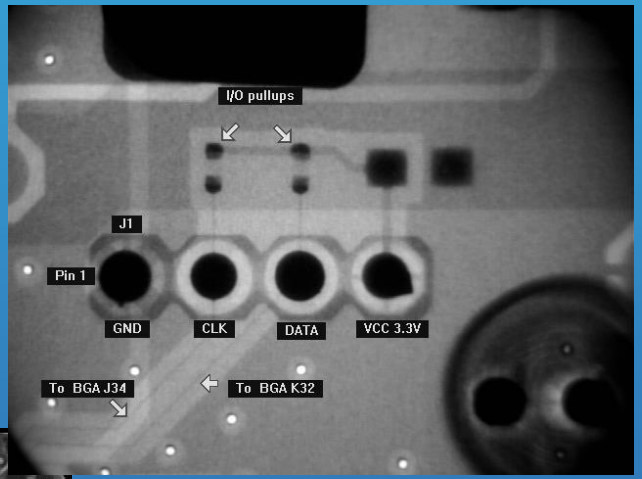
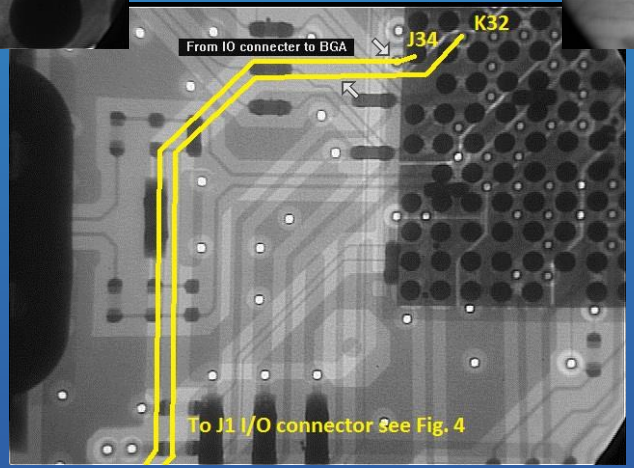
Reverse engineering BGAs becomes an easy task with X-ray







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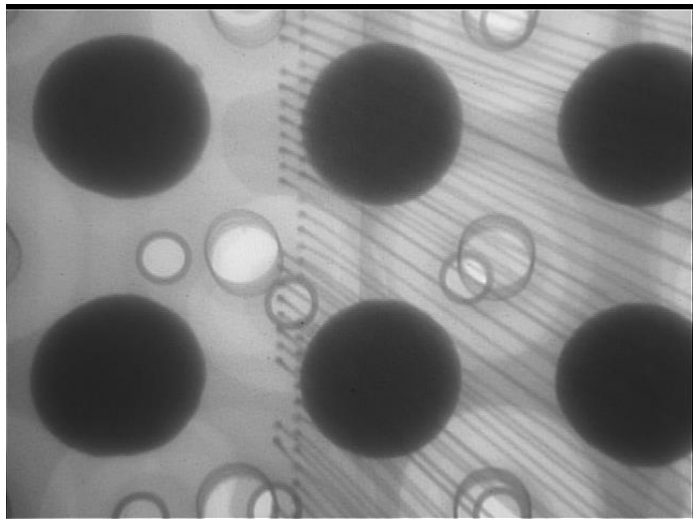
Geometric zoom allows us to see the finer details without sacrificing S/N.

.024” Spheres



BGA internal bond wires are visible

BGA VIAs and PCB VIAs

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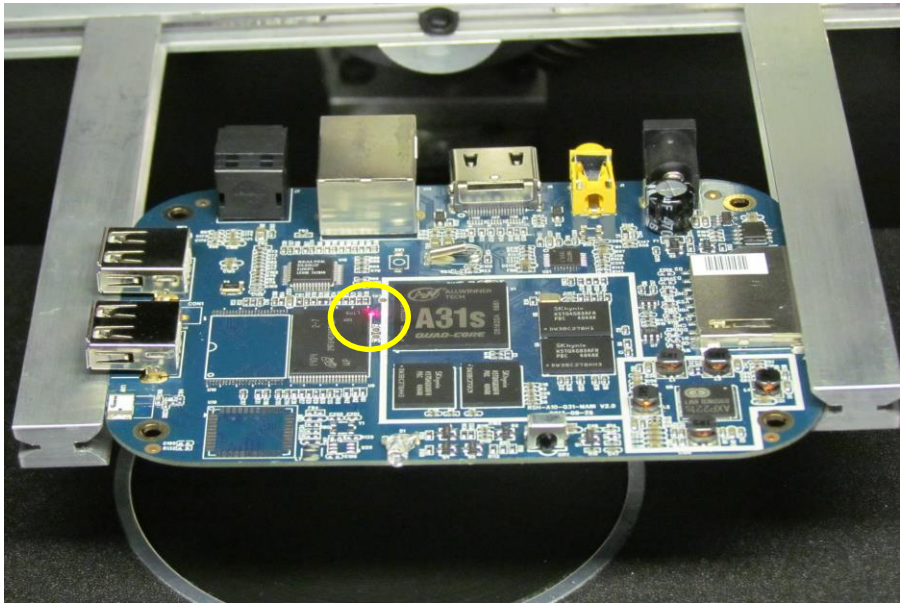
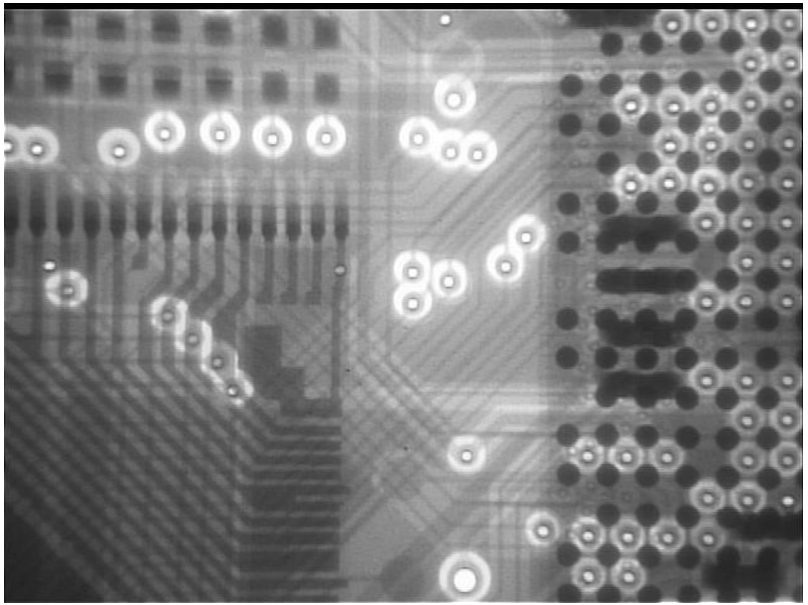
Top plane layer few traces are visible to the eye.



X-ray view of the same area circled in yellow.



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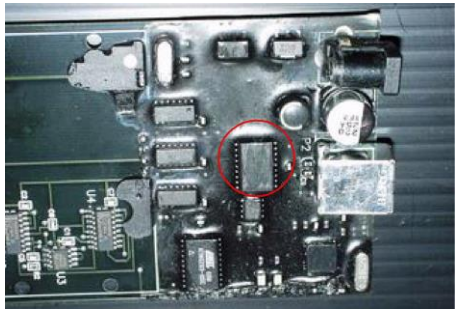
Methods to obscure the design using epoxy are ineffective when using X-ray.



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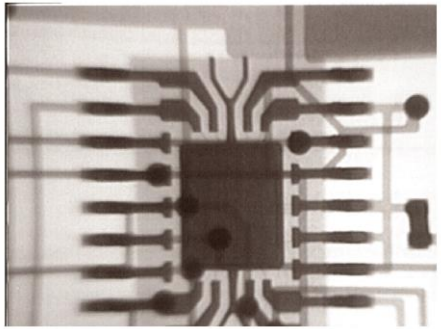



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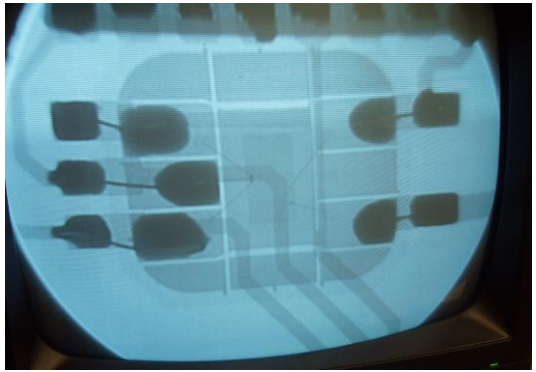

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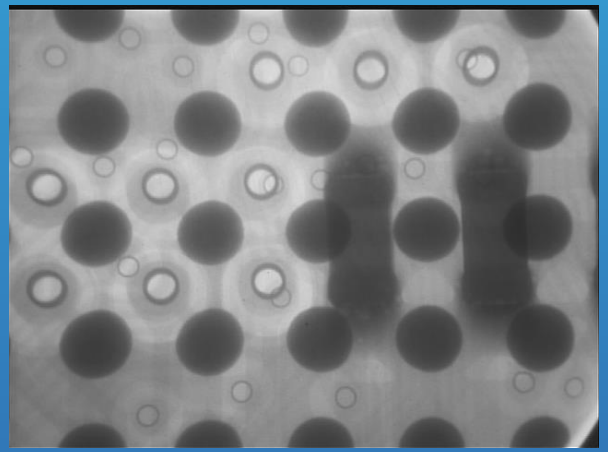
Analysis of obstructed views using lead

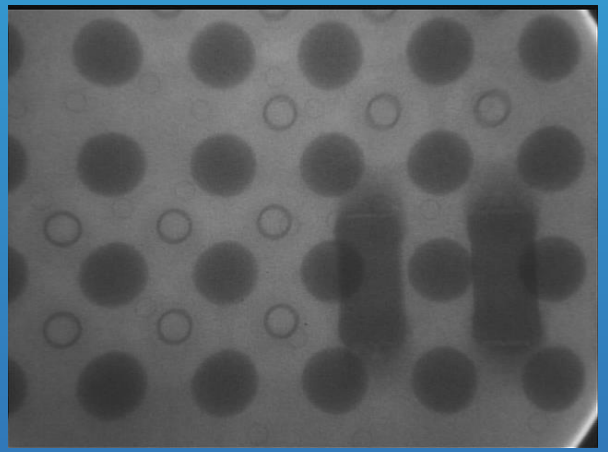
Normal View



56kv 125ua

Normal View of BGA and PCB

Lead sheet applied



79kv 99ua

Same PCB with .025” lead sheet

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RAD Hardened Devices

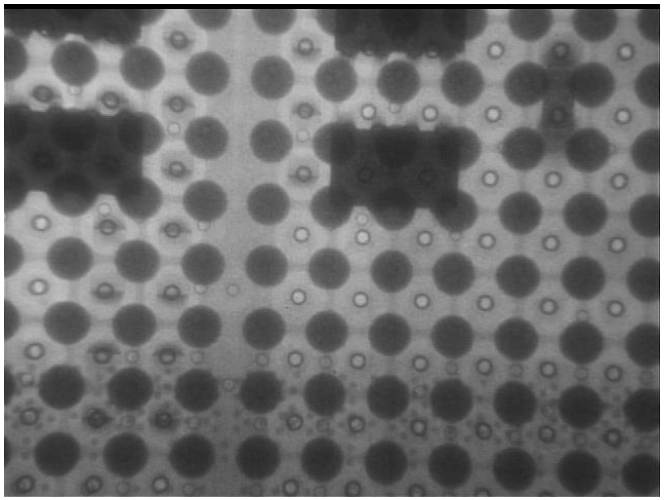

Fig. 1
Device view a bit harder to see.

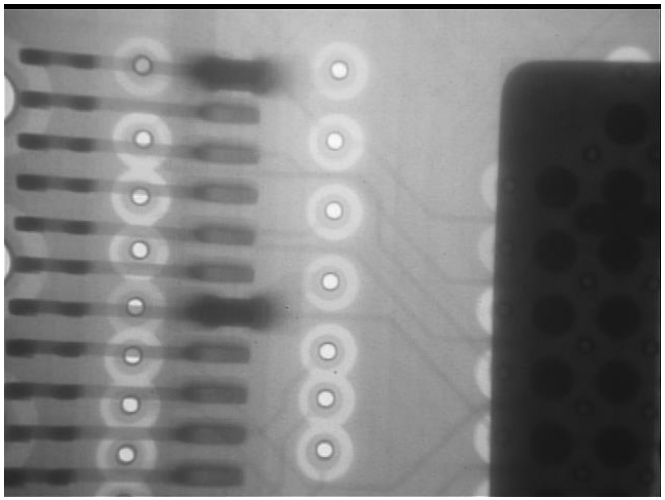

Fig.2
Hardened device compared to PCB

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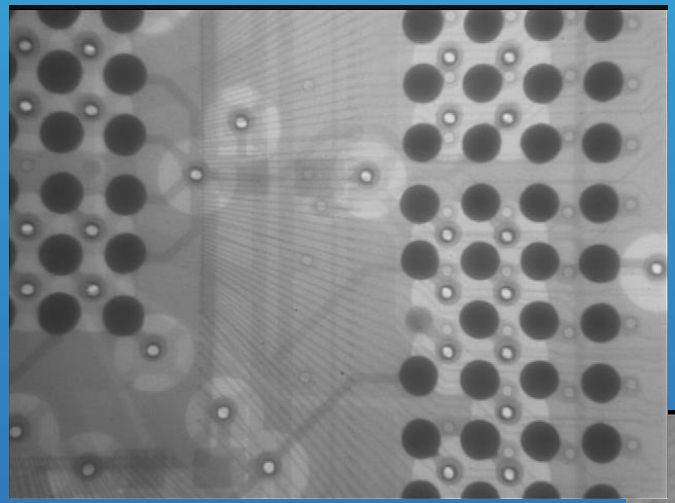
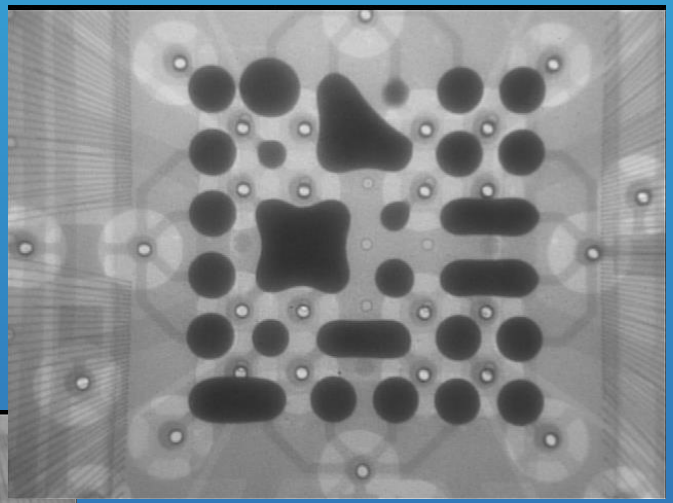
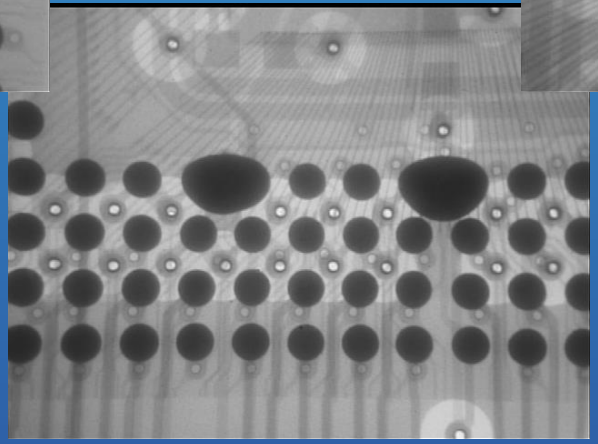
Failure Analysis







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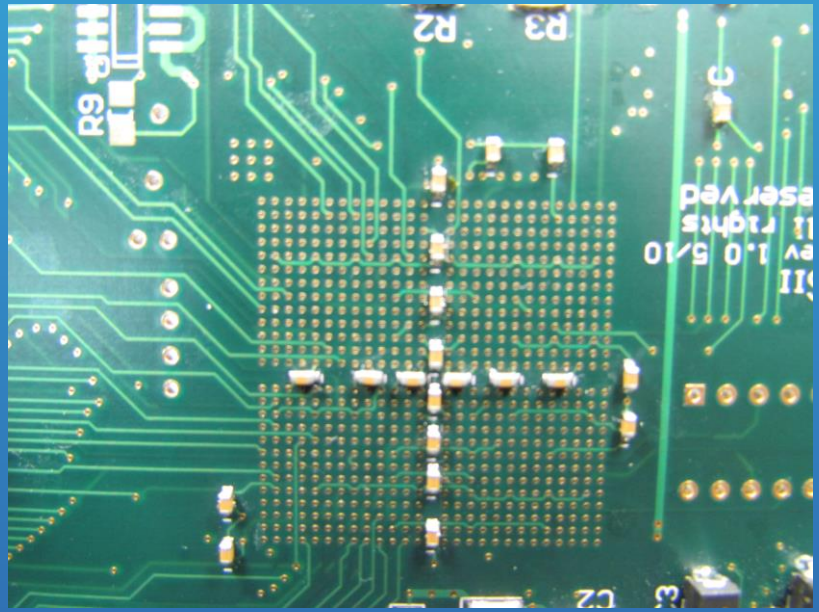
FPGA problem





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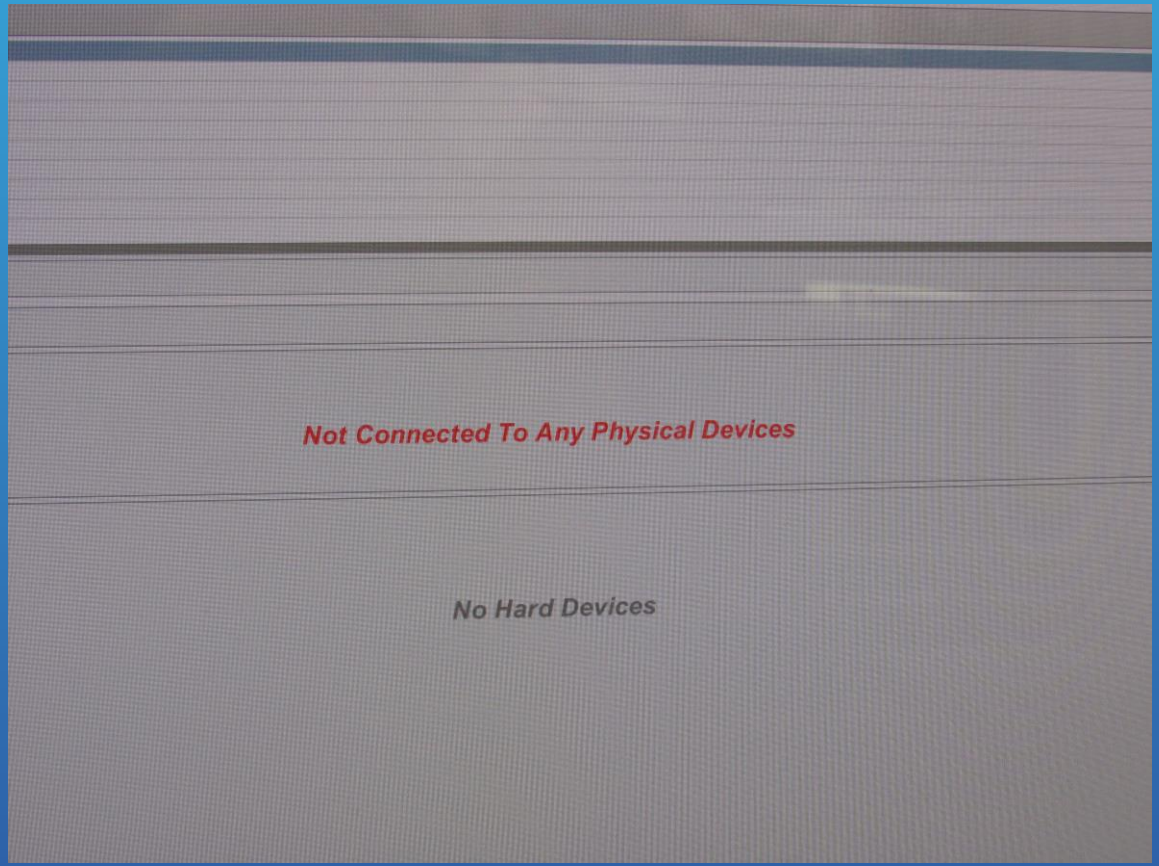
JTAG Interface Not Found



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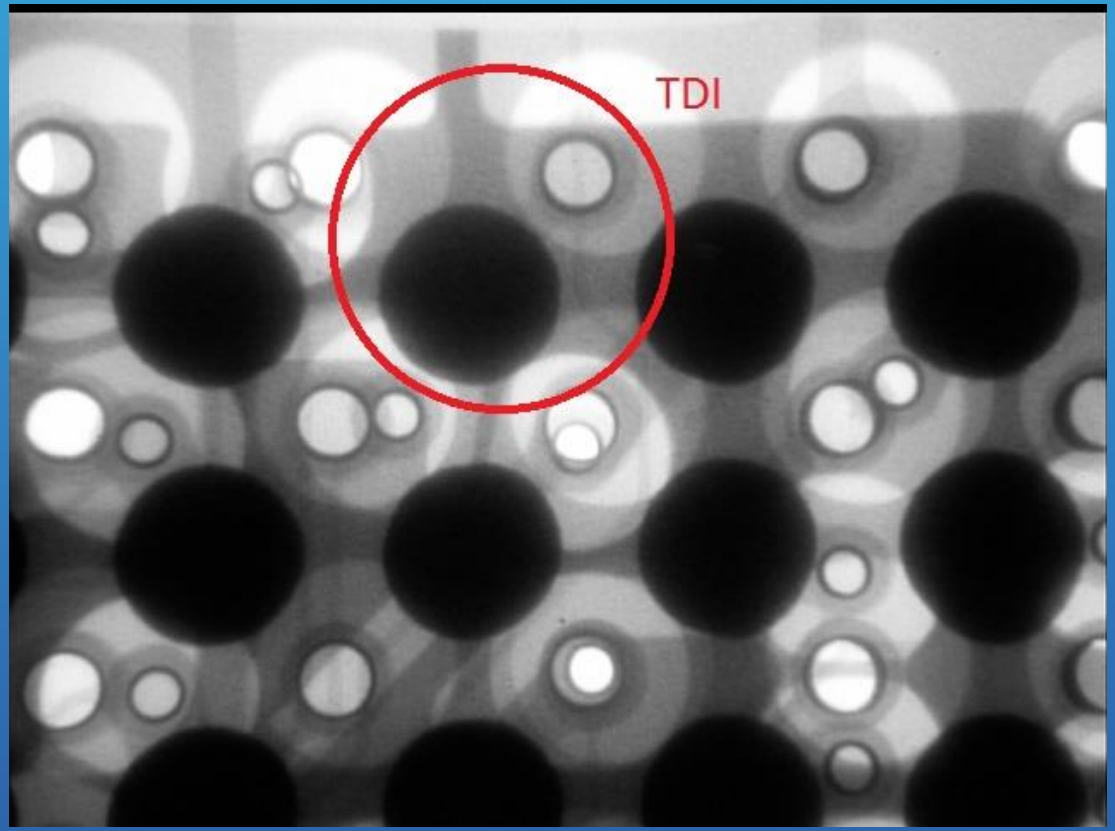
Unreachable Access, TDI VIA defective



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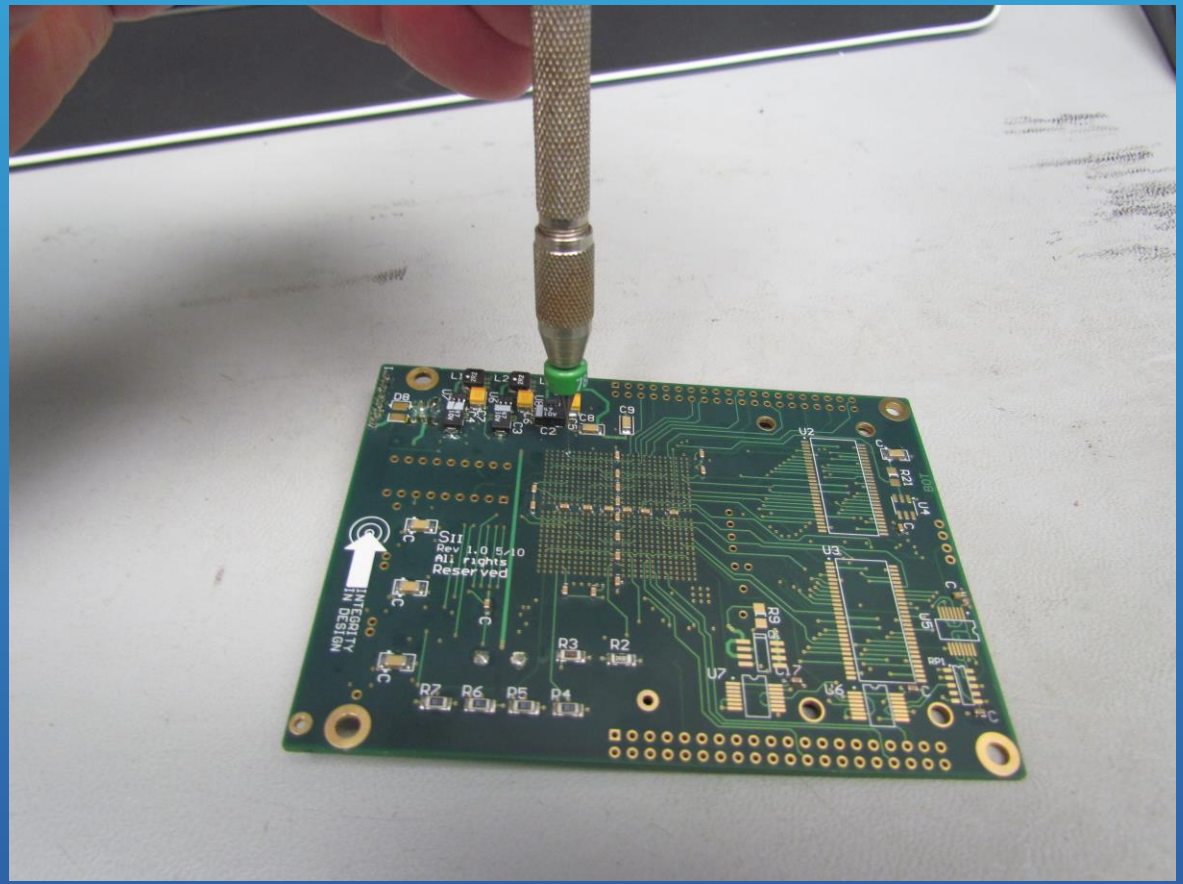

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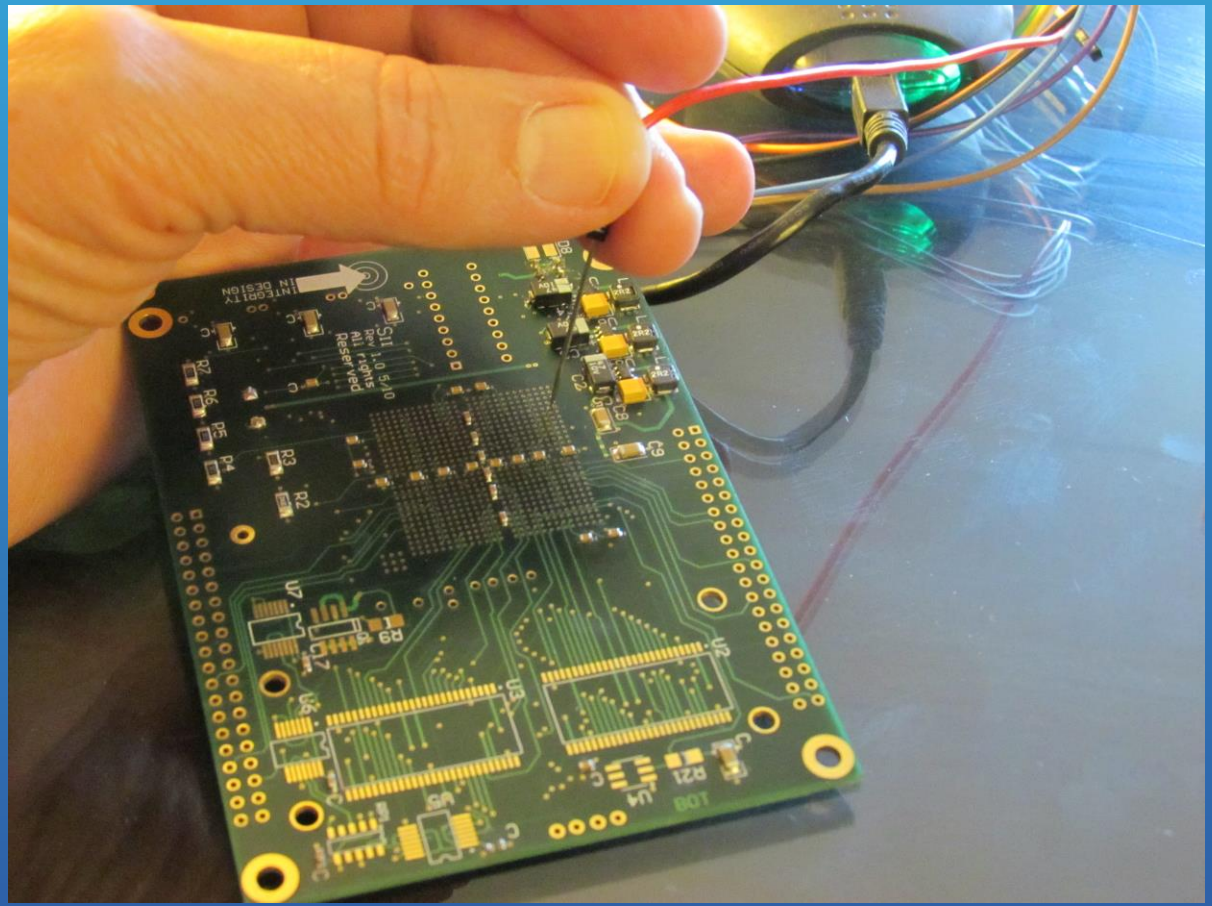
Temporary JTAG TDI Connection



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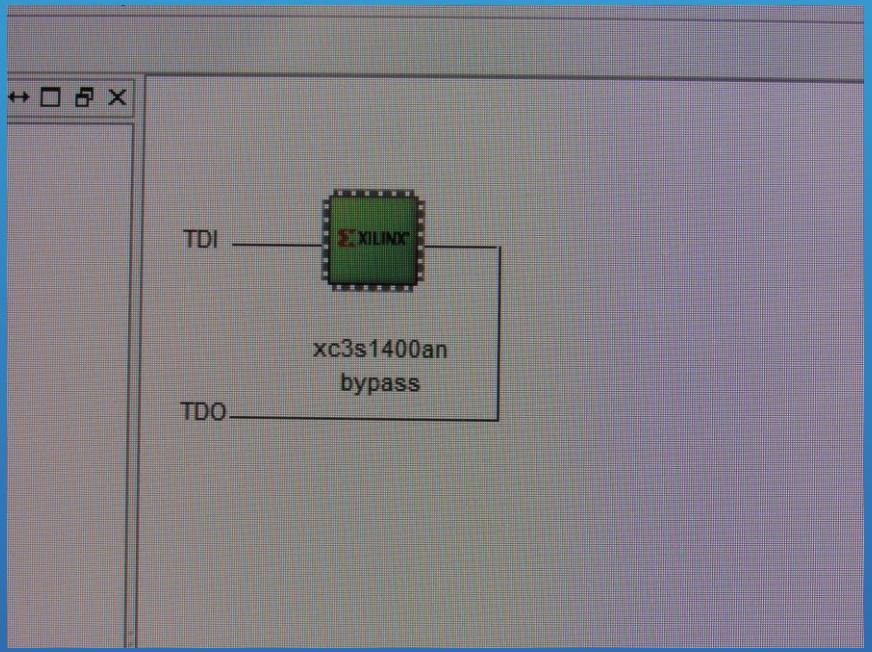
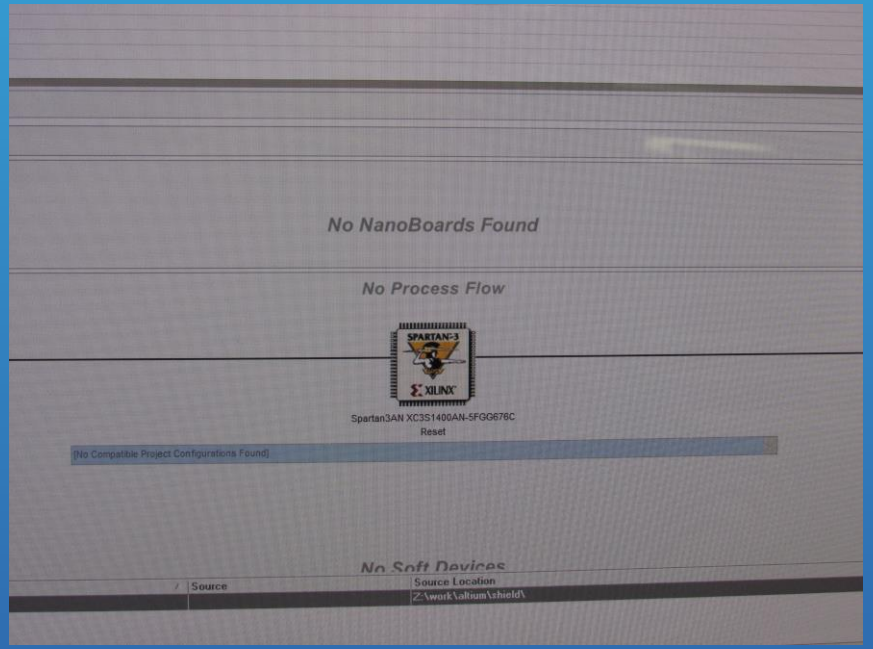
Success





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Questions?



TOMORROW starts here.