Impedance based IC identification

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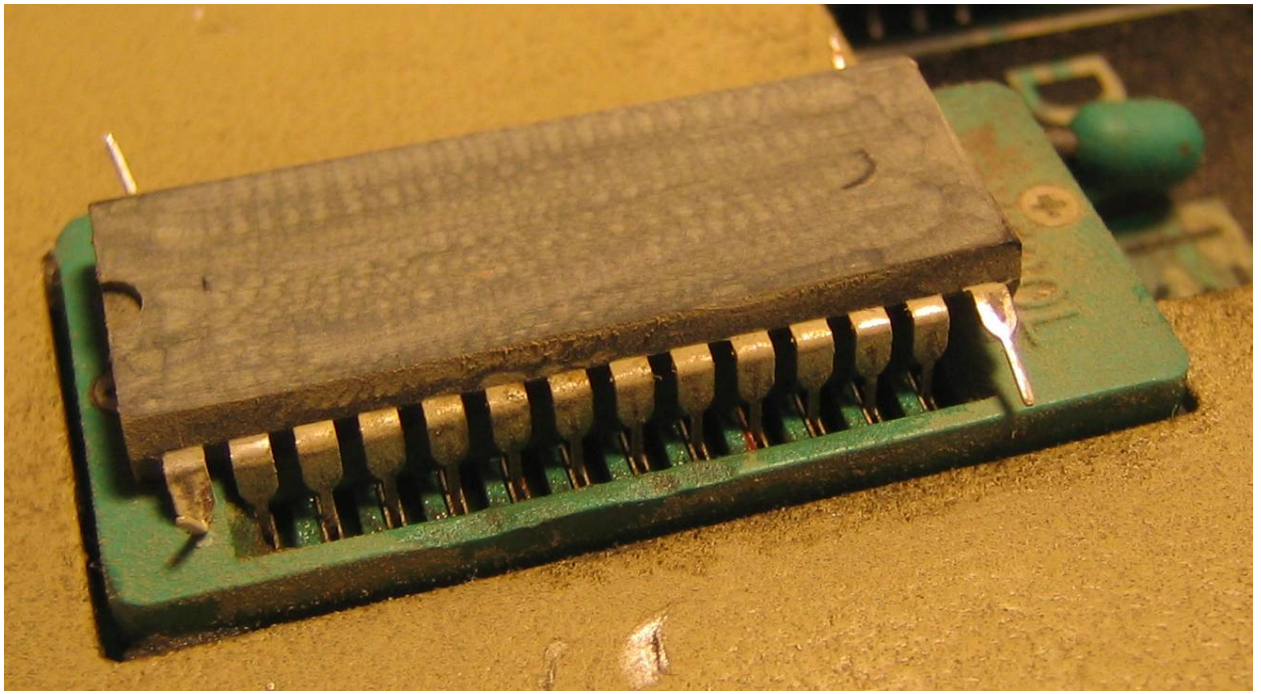
What

- Problem: identify remarked ICs
- PCB hints like package, power, reset
- Decap if insufficient
- Could we generate signature to avoid decap?

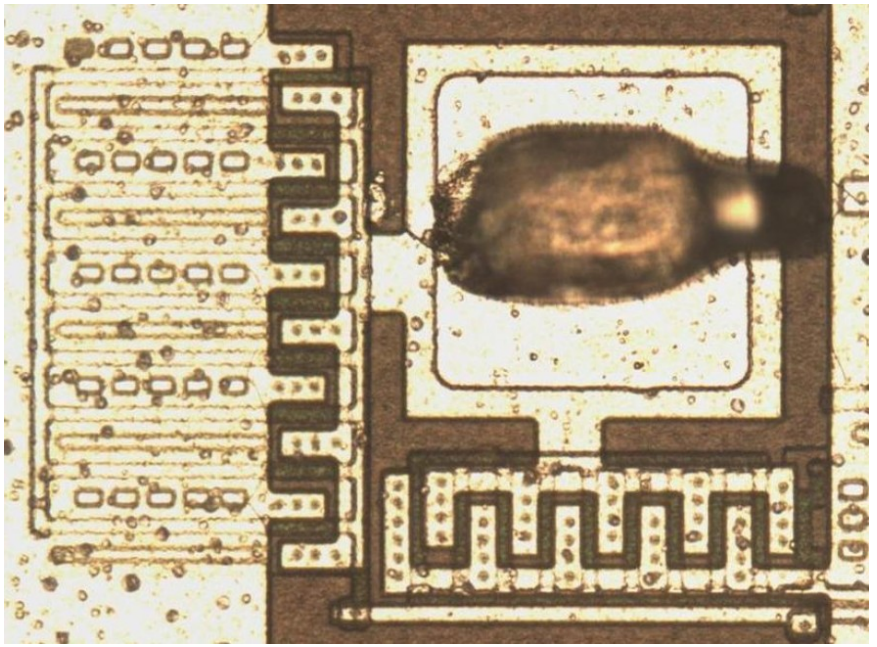


Basic idea

- Measure pin resistances to ground
- Build database of known/suspected ICs
- Compare target against reference signature
- Eventually ID pins using signature alone

Voltage polarity

- IC pads typically have ESD protection diodes
- Forward pad voltage good for signature
- Reverse pad voltage good for pad health

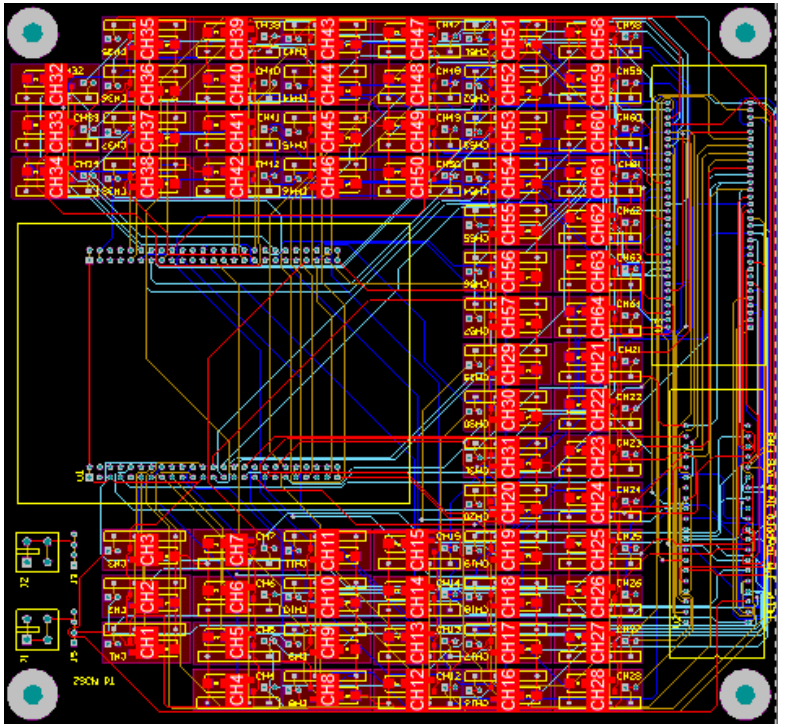


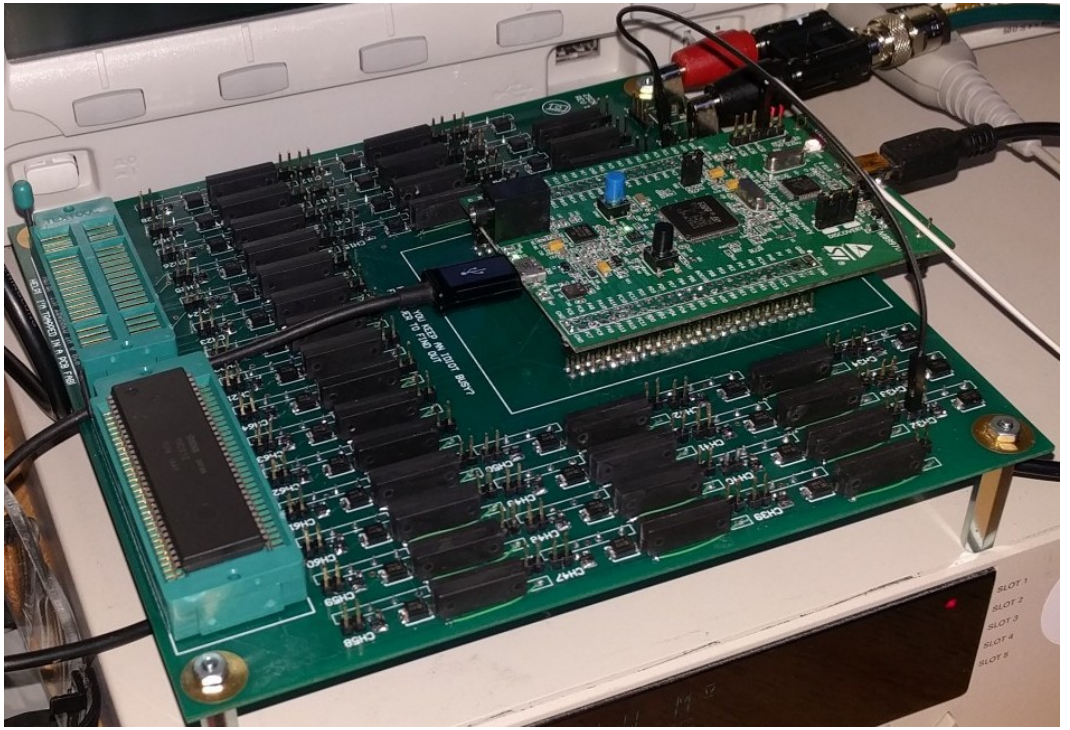
Early tests

- Initial tests verifying pad integrity after decap
- Valuable but labor intensive

Scaling up: zscn

- Mux DMM to each pin: lots of relays
- Most complex PCB I've made
- Many things to improve, but does work





Database matching

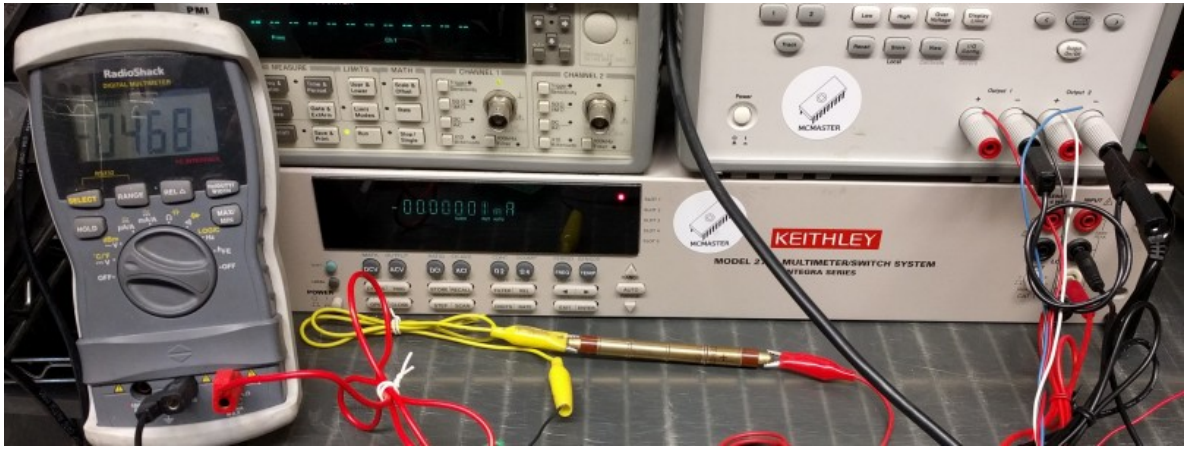
- Naive: compare resistances
- Real world: IC resistances proportional
- Normalize to median resistance
- Score based on log normalized resistance
- Very effective at clustering unknown ICs

Case study

- 3 samples from lot 1, 2 samples from lot 2
- 2 target ICs suspected to match samples
- Target1 vs DB of 30 signatures
  - 1: Target 2
  - 2: Sample 1
  - 3: Other: mask ROM version
  - 4: Sample 2
  - 5: Sample 3
  - 6: Other: same vendor, different part

Keithley 2750 resistance

- Test current depends on range
- Manual: varies, but 100Ω => 1 mA
- RS DMM: 2.7R @ mA, 101.5R @ uA
- 0-2Ω: 10 mA, 2Ω-2k: 1 mA, 2k-20k: 100uA, 20k-2M?: 10 uA, 10M: ~0.3uA
- Vmax: 2V?



Curve tracing

- Silicon is nonlinear => resistance isn't 1 value
- Want: Keithley SourceMeter
- But...3 generations ago: still $400-700 used!

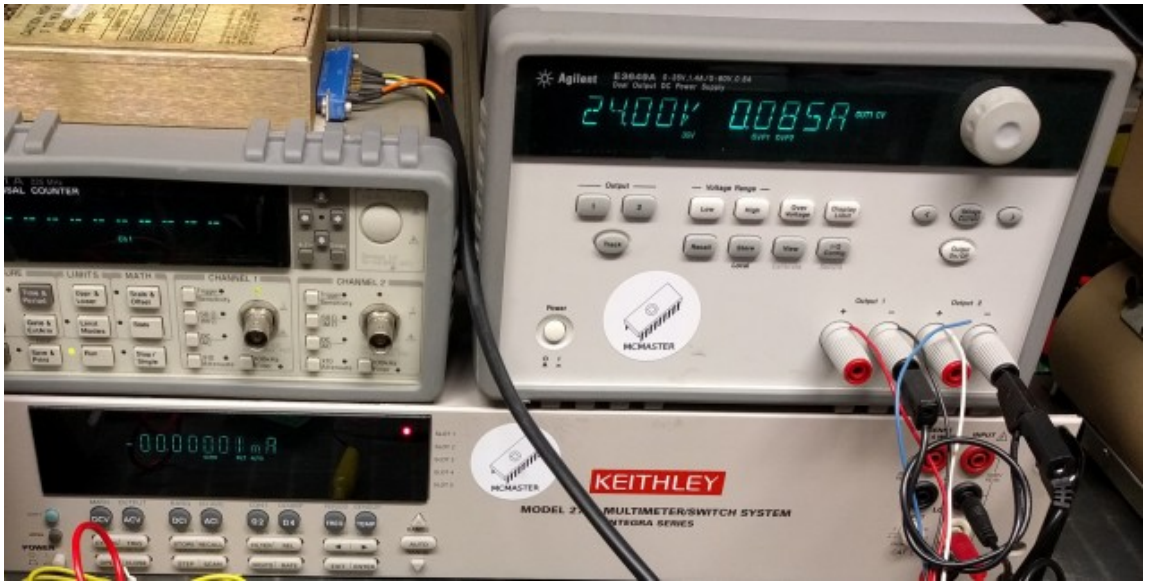
Seller information

mcstorefixtures (591 ★)

93% Positive feedback

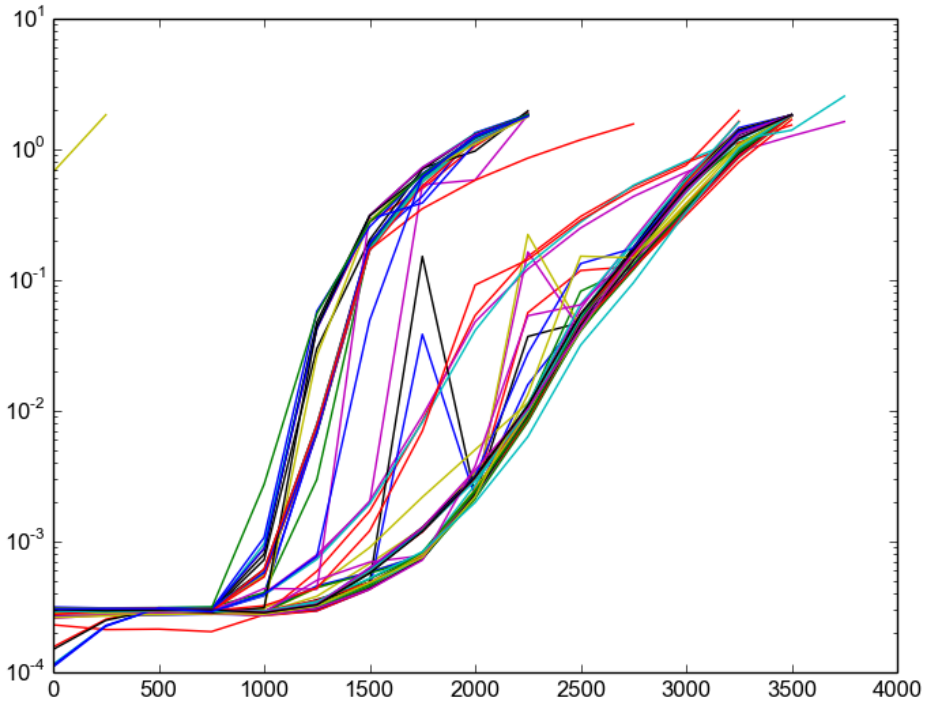
Curve tracing

- Fell back to tools on hand
- Agilent E3649A PS + Keithley 2750 DMM
- Current limit: 1.5 mA soft, 2 mA (1.8 mA) hard

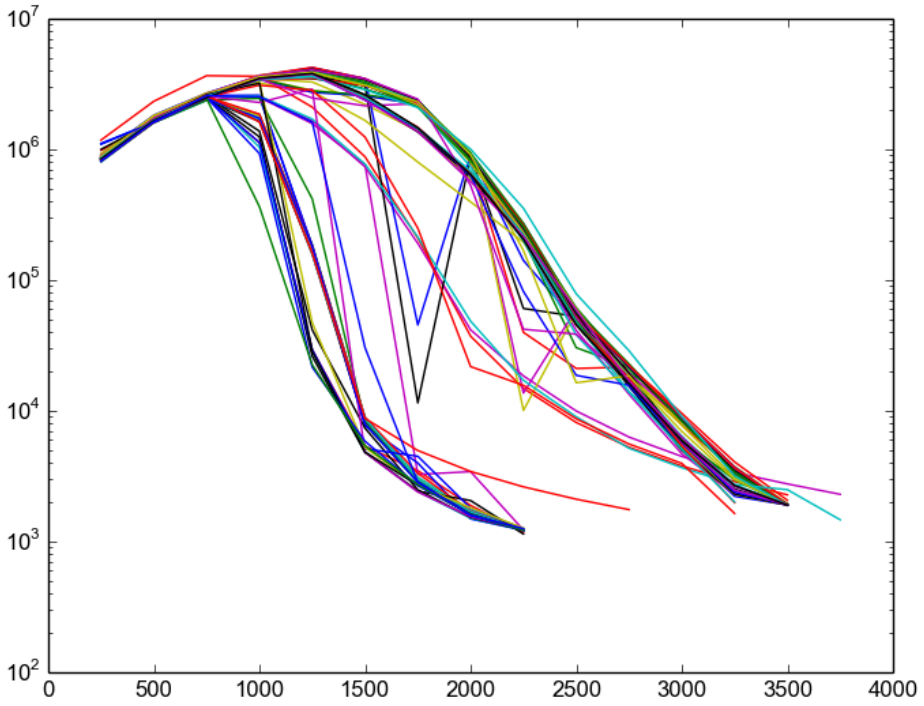


Curve tracing

- Needs more analysis



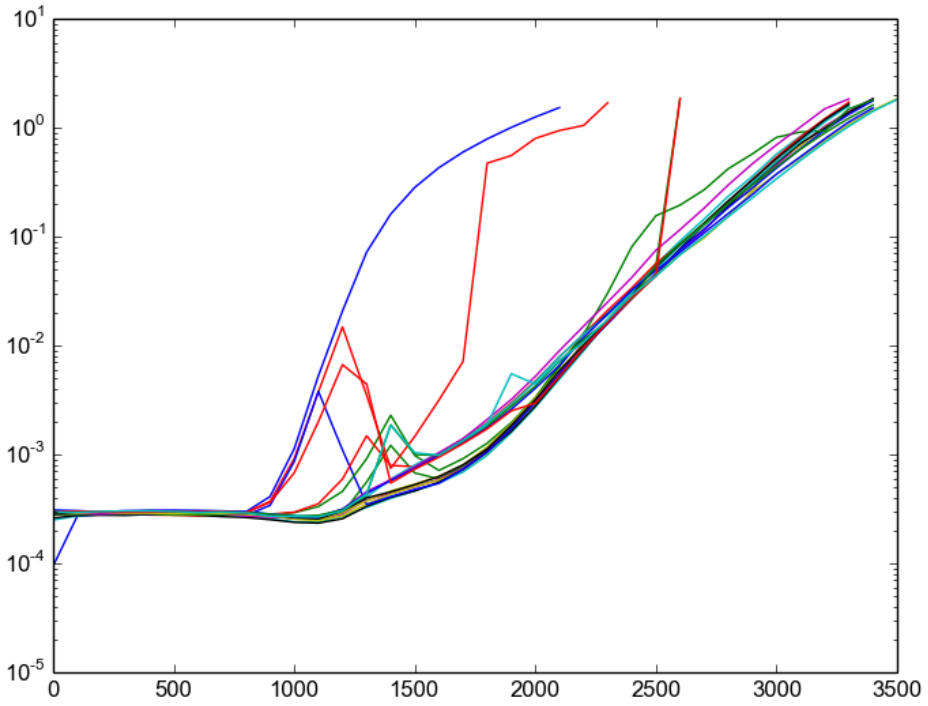
I vs V



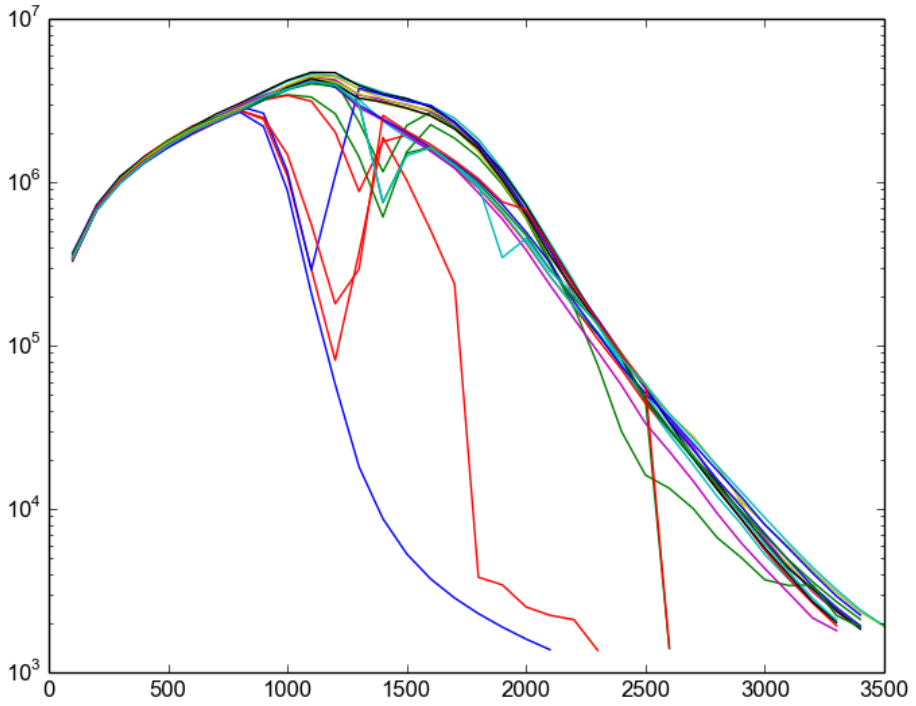
R vs V

Curve tracing: different settle time

- Capture parameters critical



I vs V



R vs V

Chip safety

- How much current/voltage can safely be put on pin?
- Don't go above PCB VCC
- 2750 basically max 3V @ 1 mA
- Ran on a number of test chips first

Next steps

- Refine curve tracing
- Measure C, L, frequency response, etc
- Apply more advanced statistics
- Identify common pins w/o datasheet?
  - Power
  - Input vs output
  - Crystal
- Damage threshold tests

Thanks for listening!

- Questions? Interested?
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