

25GB/s Socket and Loadboard Test Issues

Thomas P. Warwick

R&D Circuits, Inc.

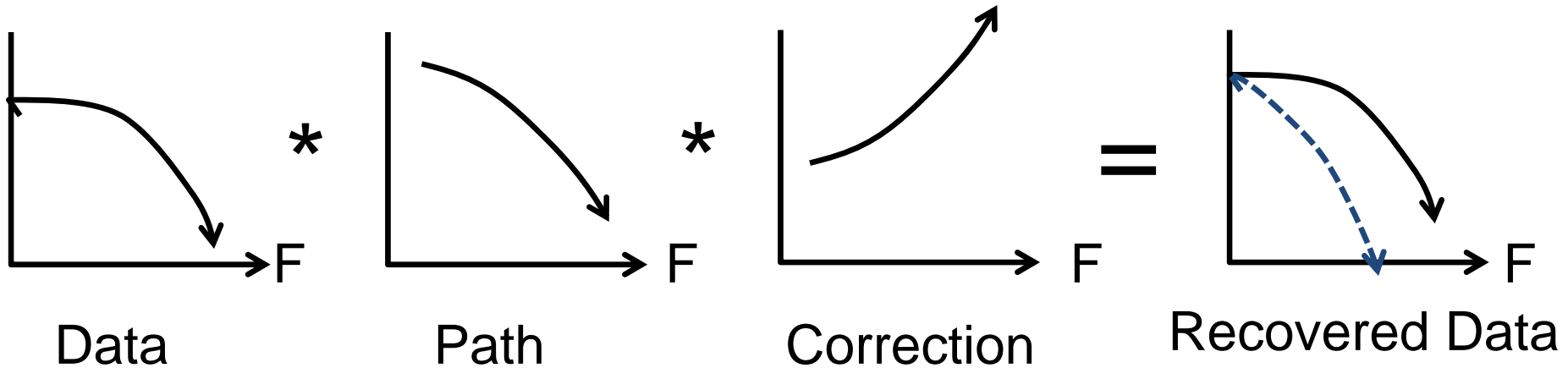
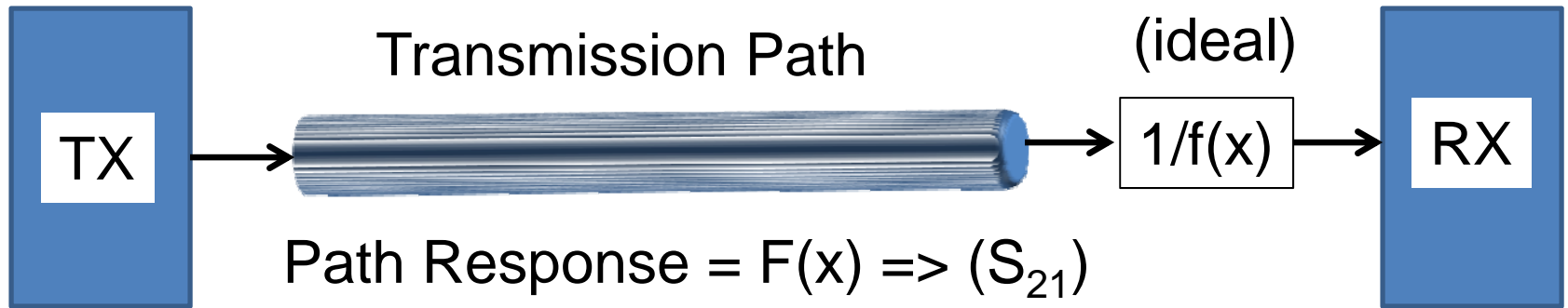
pwarwick@rdcircuits.com

Purpose and Outline

This presentation discusses on-going issues relative to the development of repeatable and effective test implementations for 25GB/s devices.

- Review of Correction Methods
- Primary Issues of Concern
- Via Structure
- Loadboard Consistency / Repeatability
- Power Delivery
- Concluding Comments

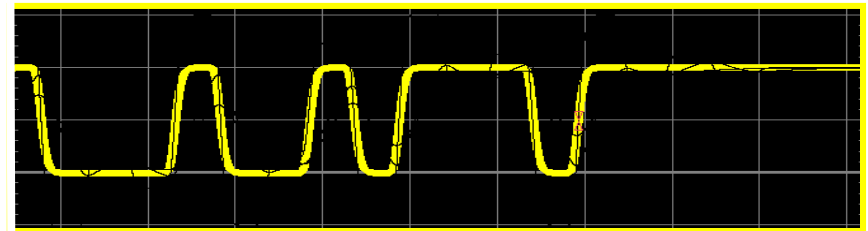
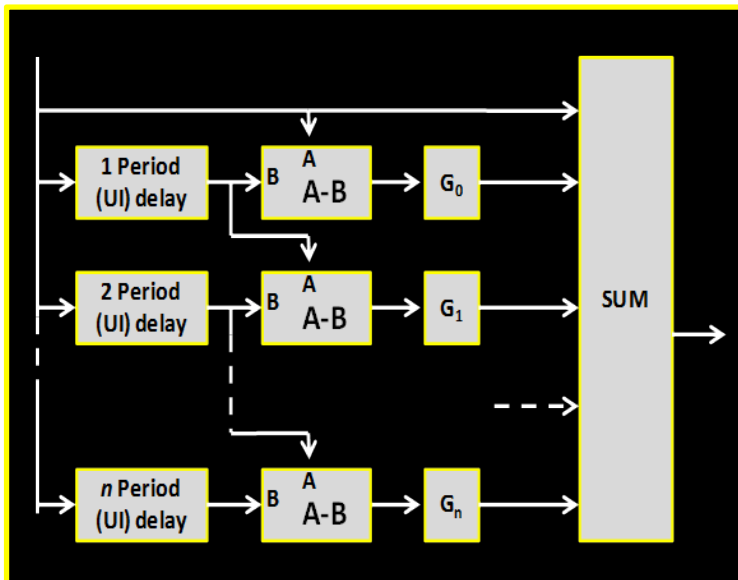
Review of Correction



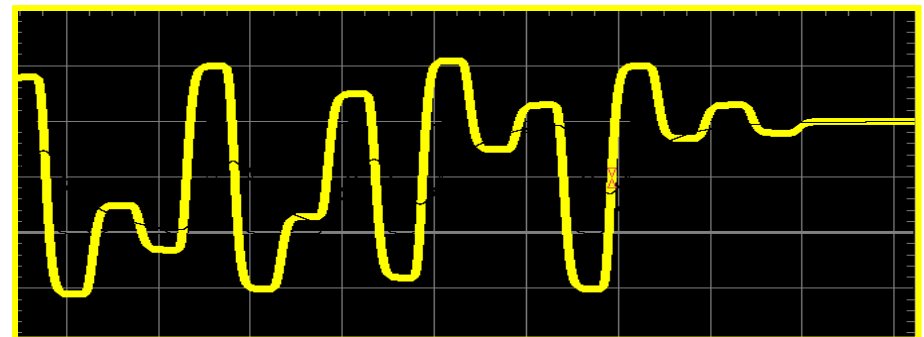
Review of Correction

In implementation, $1/S_{21}$ implementation is not practical in a broad sense. Therefore an “FIR” filter is used with a sampling rate based on the data period (under-sampling).

Pre-emphasis FIR

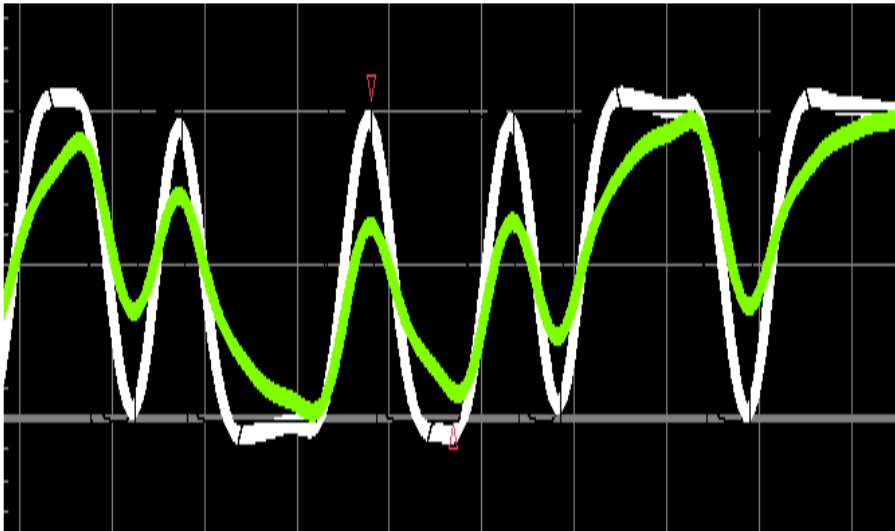


Pattern After Correction

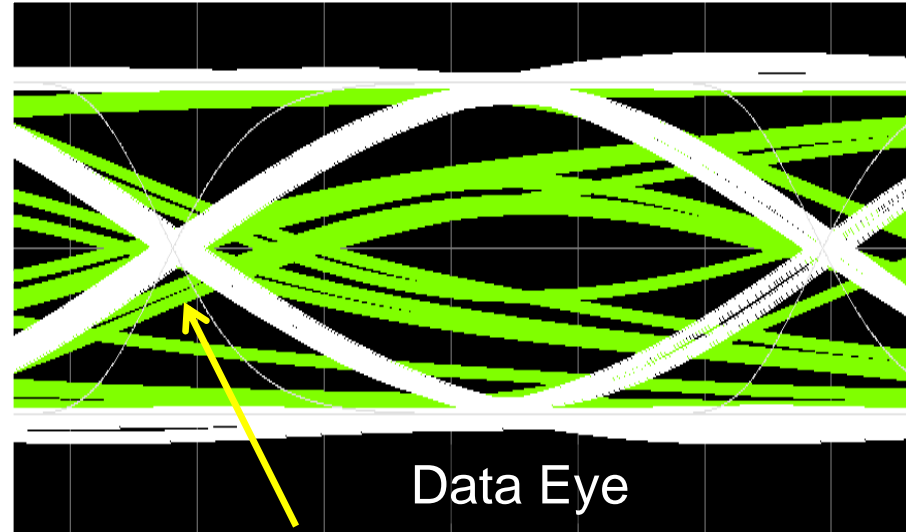


Review of Correction

Corrected



Uncorrected

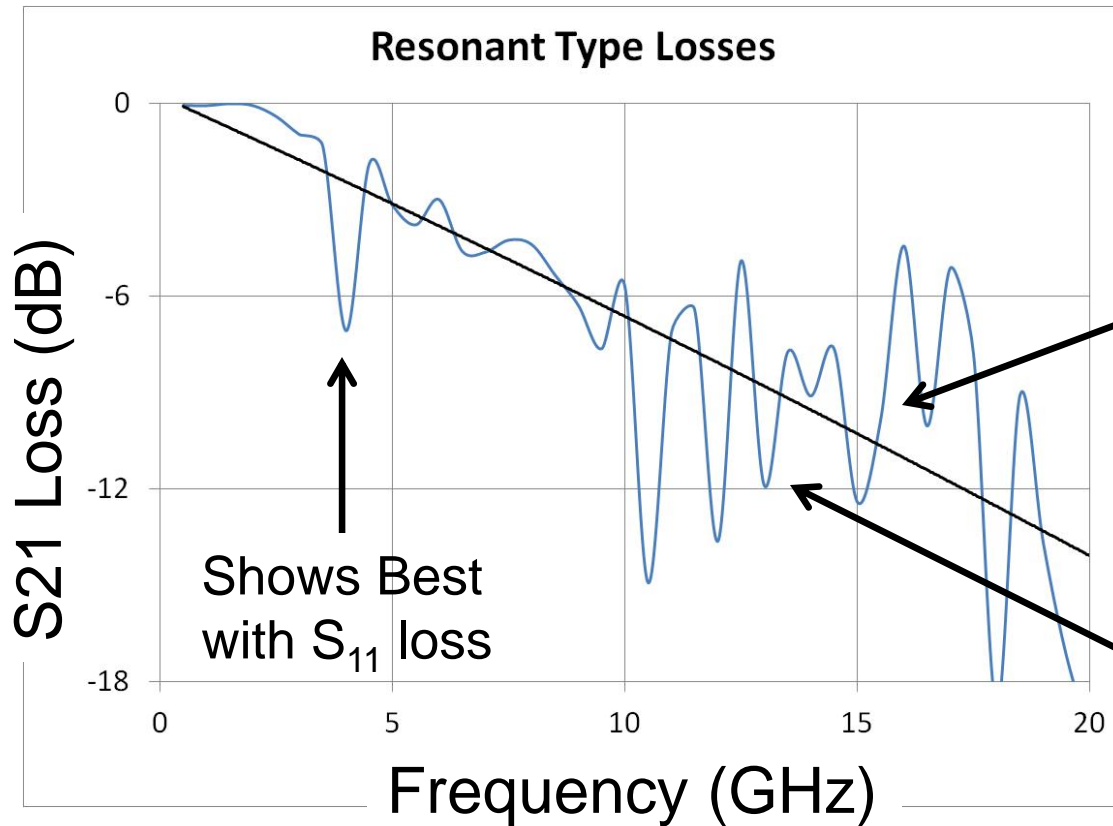


“Block correction” and other methods correct for other jitter sources (i.e. random jitter, uncorrelated jitter, etc.)

-- But correction has its limitations --

Primary Issues

RESONANCE POINTS



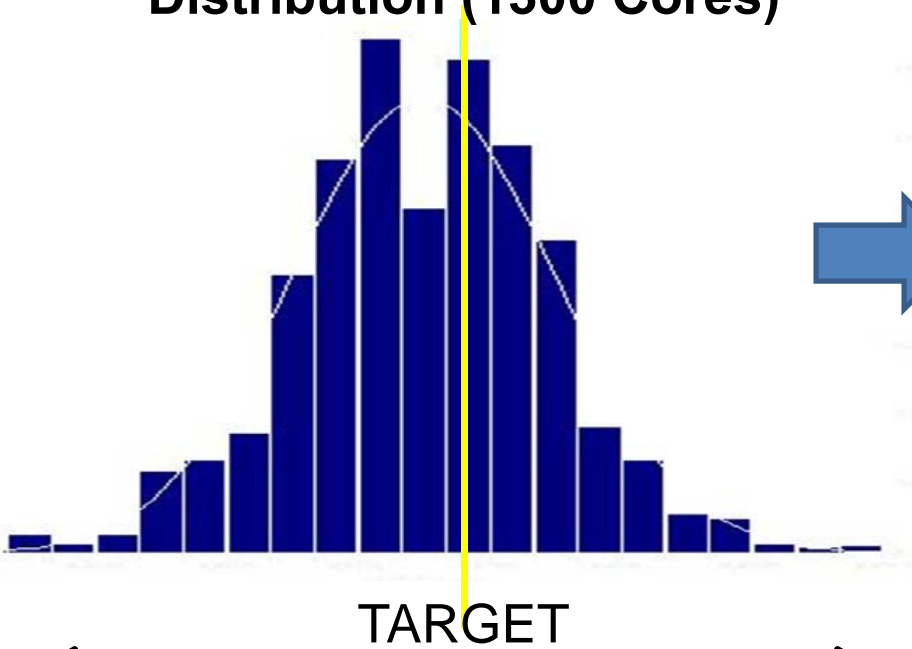
Under-sampling FIR tap structures must assume monotonic loss

Vias and sockets cause resonant points

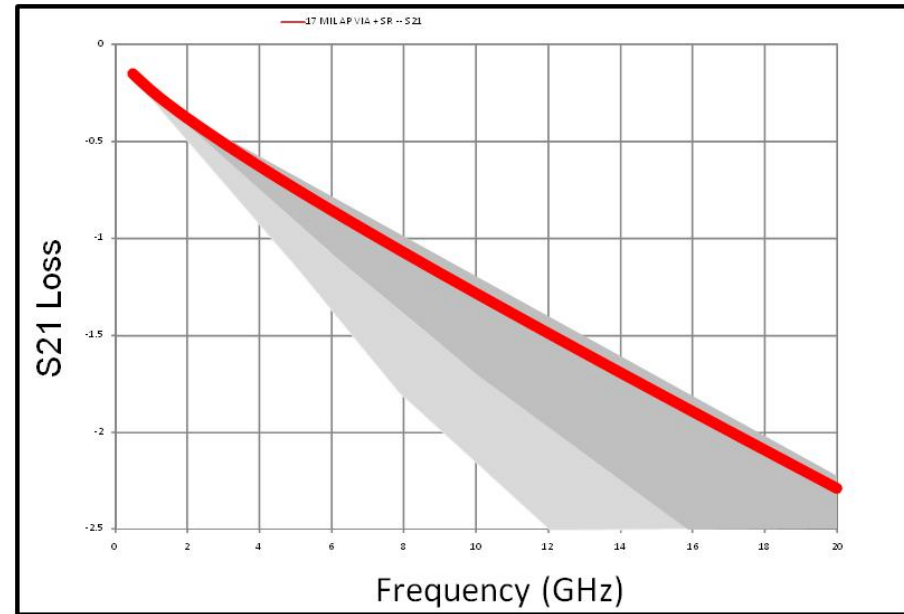
Primary Issues

Site to Site Measurement Repeatability

High Performance Core
Distribution (1300 Cores)

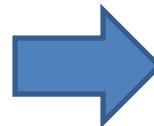


LOSS REPEATABILITY



←————— TARGET —————→

+/-10% Thickness variation

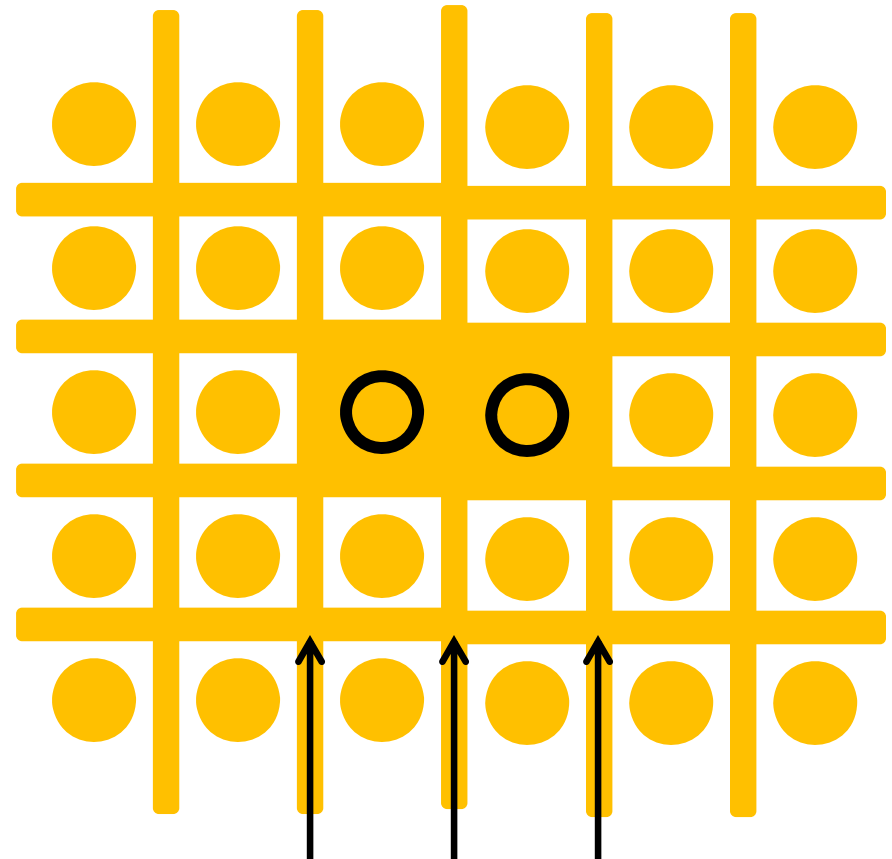
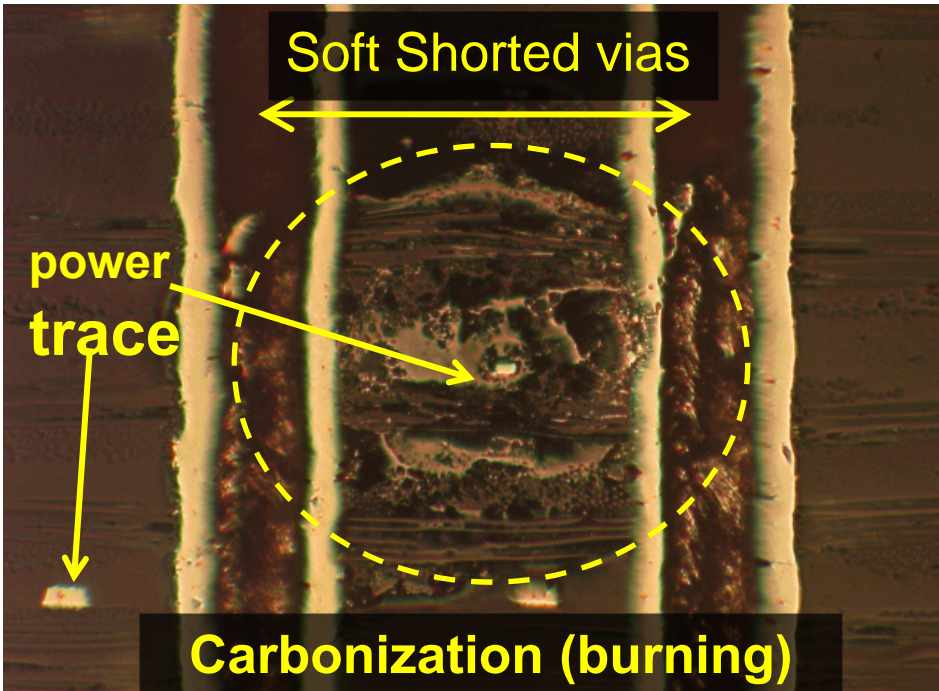


+/- 6% Impedance Variation



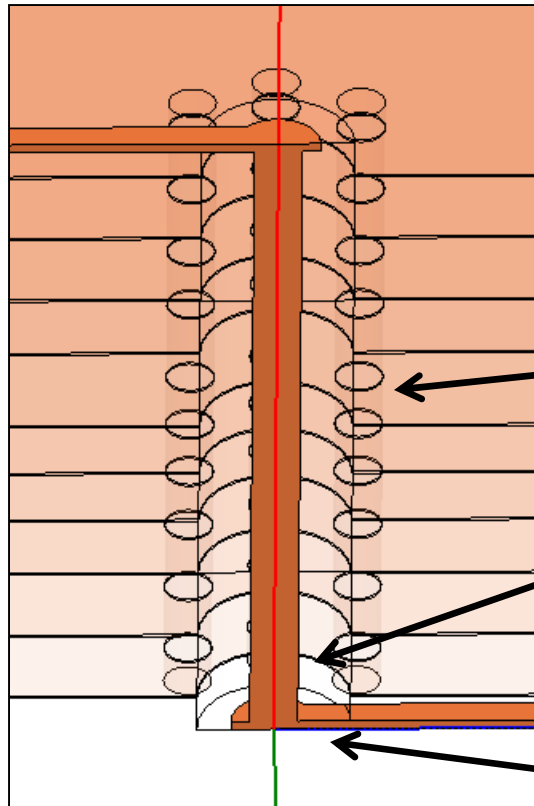
Primary Issues

Power



>300ma in a web for 0.4mm pitch

Via Structures



Classic Via Impedance Depends on:

↕ Ground (Pwr) Plane Spacing

← Surrounding Ground Vias

← Via Anti-pad

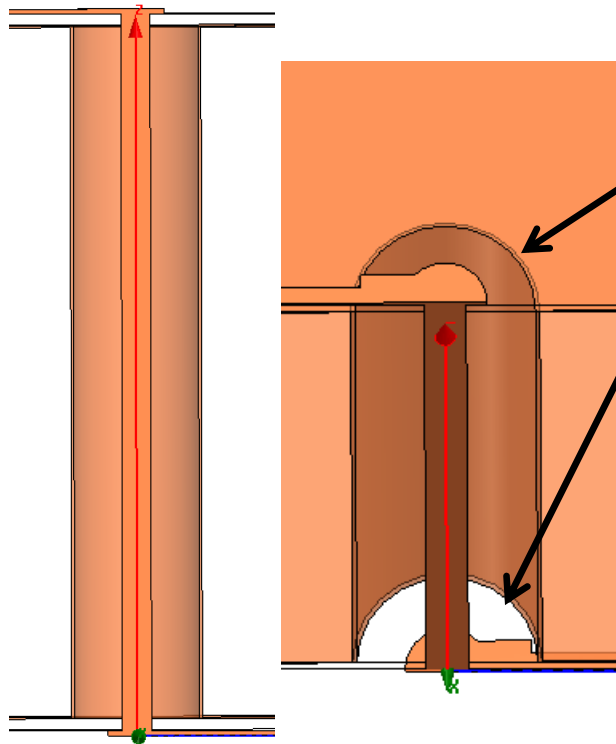
← Right Angle Bend:

← Entry Pad + Trace Width + Anti-pad

End Result: frequency dependent structure

Via Structures

Coaxial Via: very consistent impedance

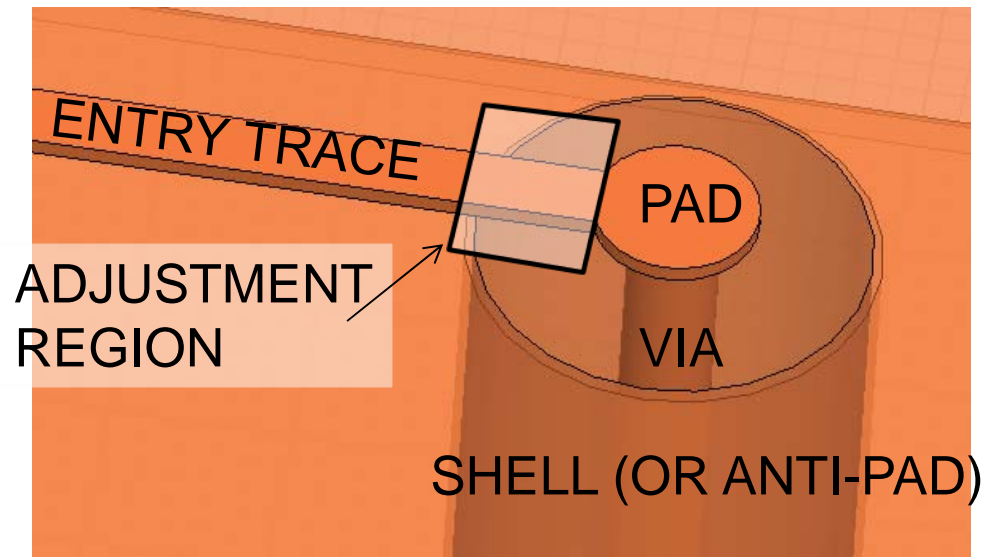


Only Impedance Dependency is the
Right Angle Bend:
Entry Pad + Trace Width + Anti-pad

Other Benefits:

- *Higher density* than surrounded gnd vias
- Lower Crosstalk

Via Structures



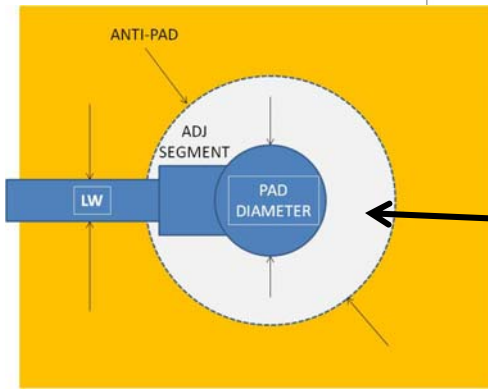
GENERAL GUIDELINES:

MICROSTRIP / NARROW TRACE RELATIVE TO PAD: ADJUSTMENT $< Z_0$

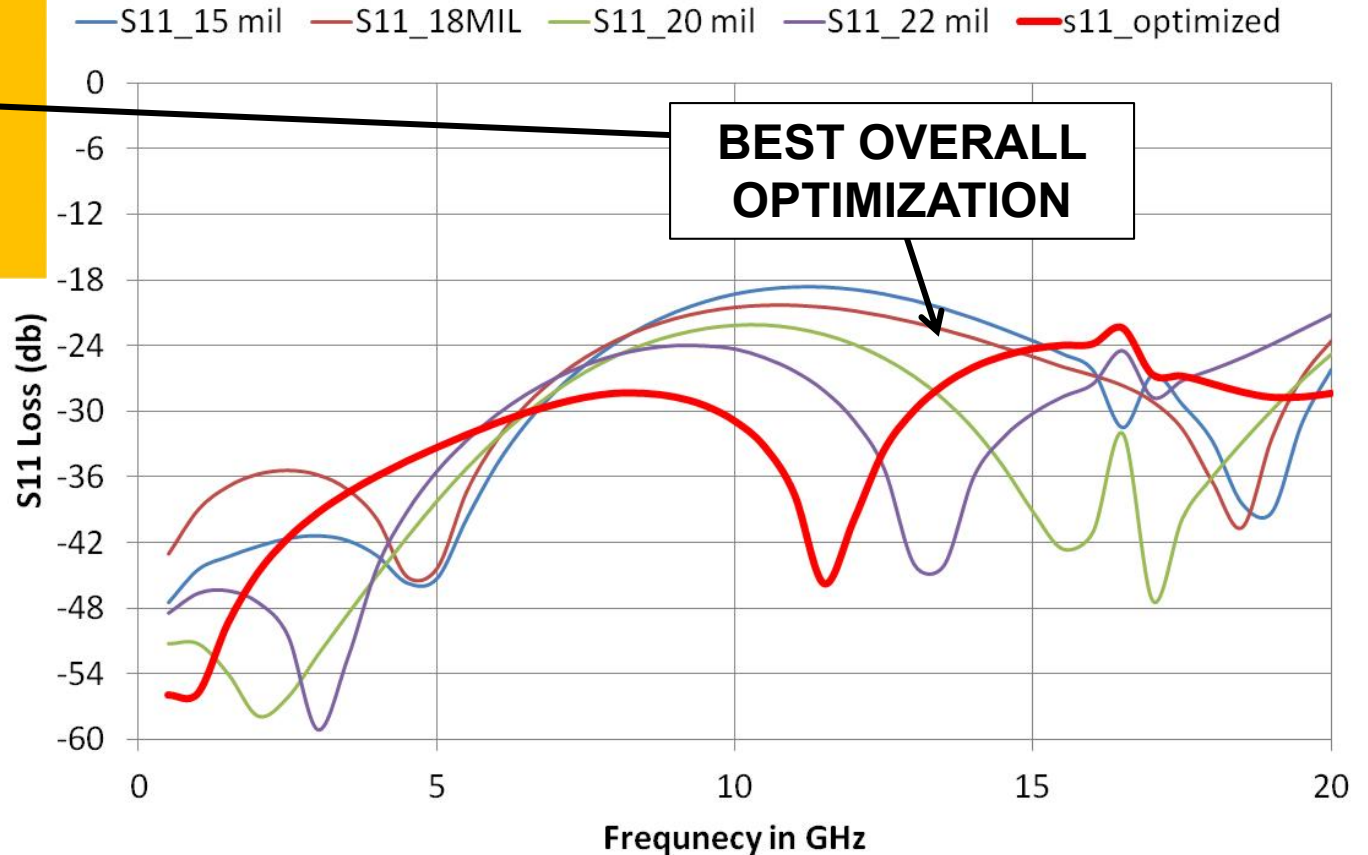
MICROSTRIP / WIDE TRACE RELATIVE TO PAD: ADJUSTMENT $> Z_0$

STRIPLINE / WITH STUB: ADJUSTMENT $> Z_0$

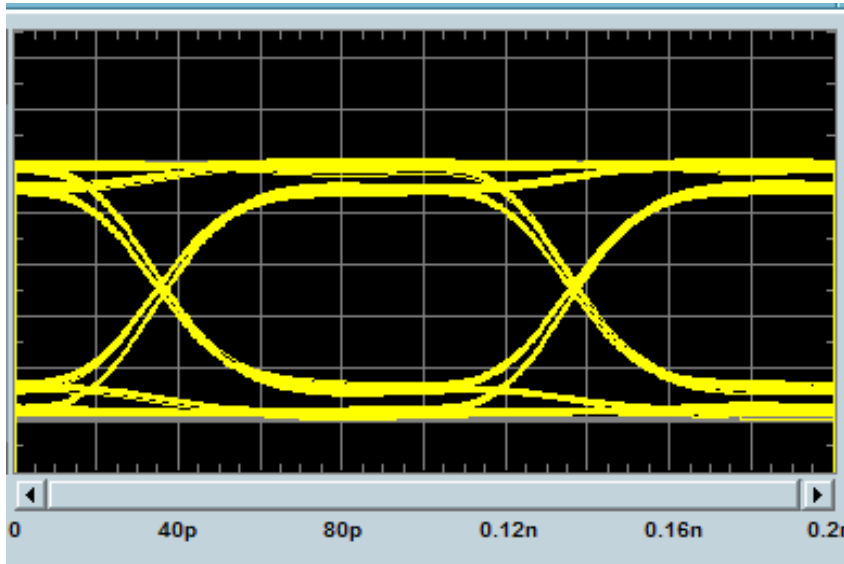
Via Structures



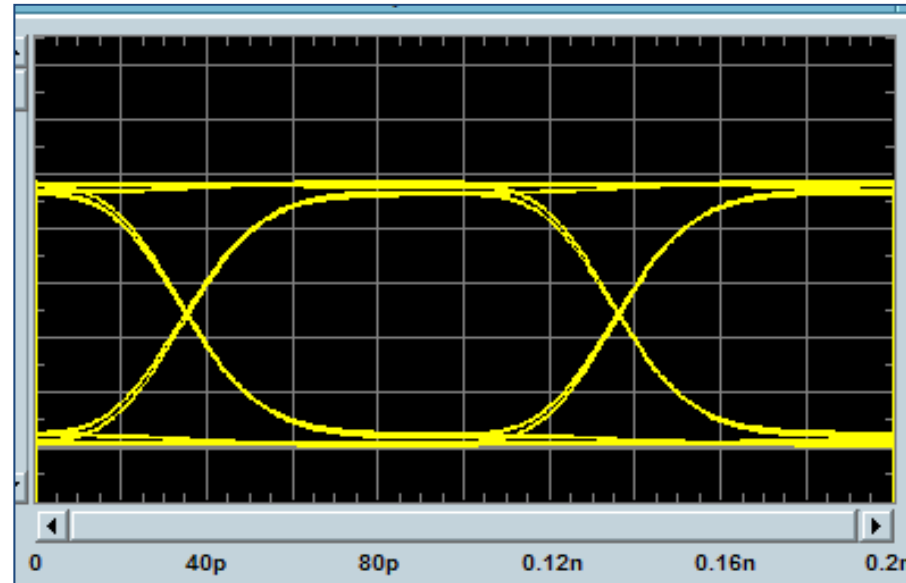
Comparison of the Effect of Via Pad Size on S11 Loss
(7.5 mil microstrip entry 10 mil core - 42.9 mil shell coaxial via)



Via Structures



Optimized Anti-pad Adjusted,
Surrounded by Ground Via
10GB/s



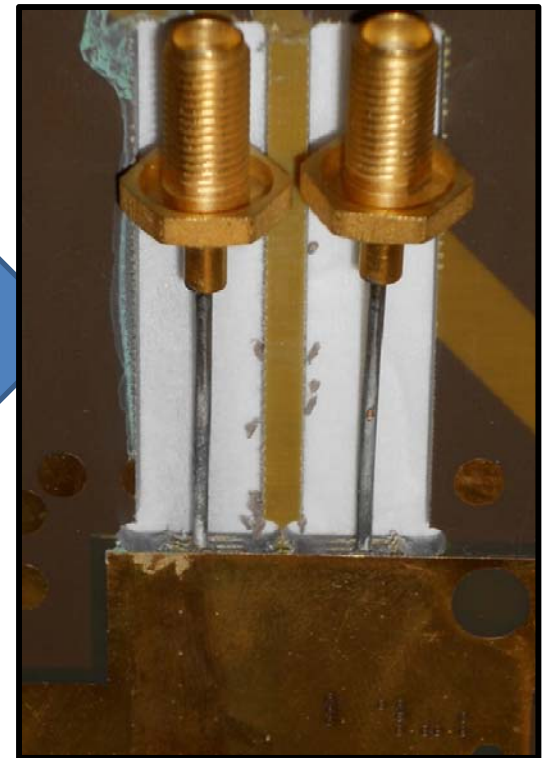
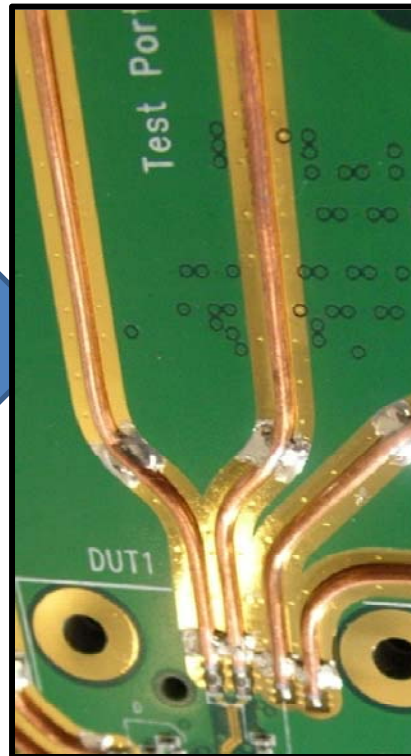
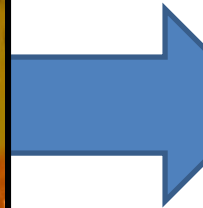
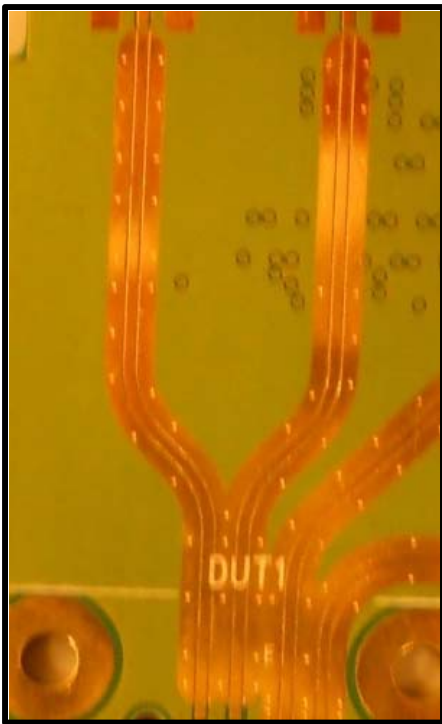
Coaxial Via
10/GB/s

Board Repeatability

- Greatest issues are in Material Thickness
 - General Guidelines
 - ✓ Core to Core Variation +/-10% >> +/-6% Impedance Variation
 - ✓ Within Core Variation +/- 5% >> +/- 3% Impedance Variation
- “Prepreg” material variability is much worse than “Cores” (= use of offset striplines)
- Traces with consistent Surrounding Copper Etch with lowest variability (e.g. co-planar wave-guide or like structures)

Board Repeatability

Emerging PC Board Methods



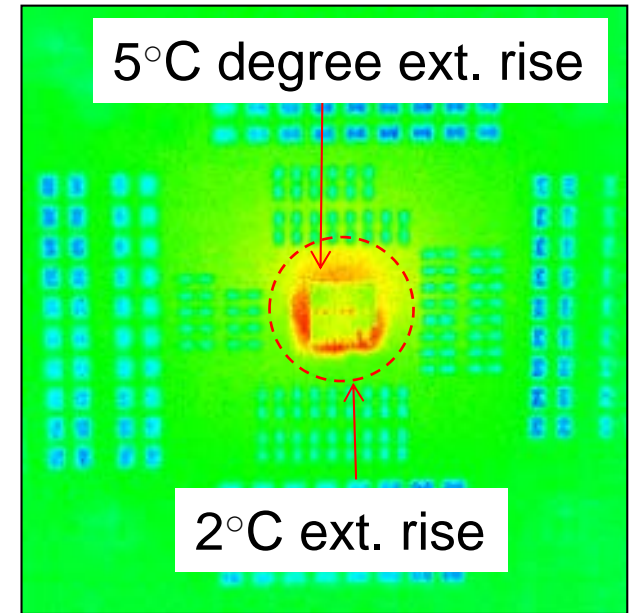
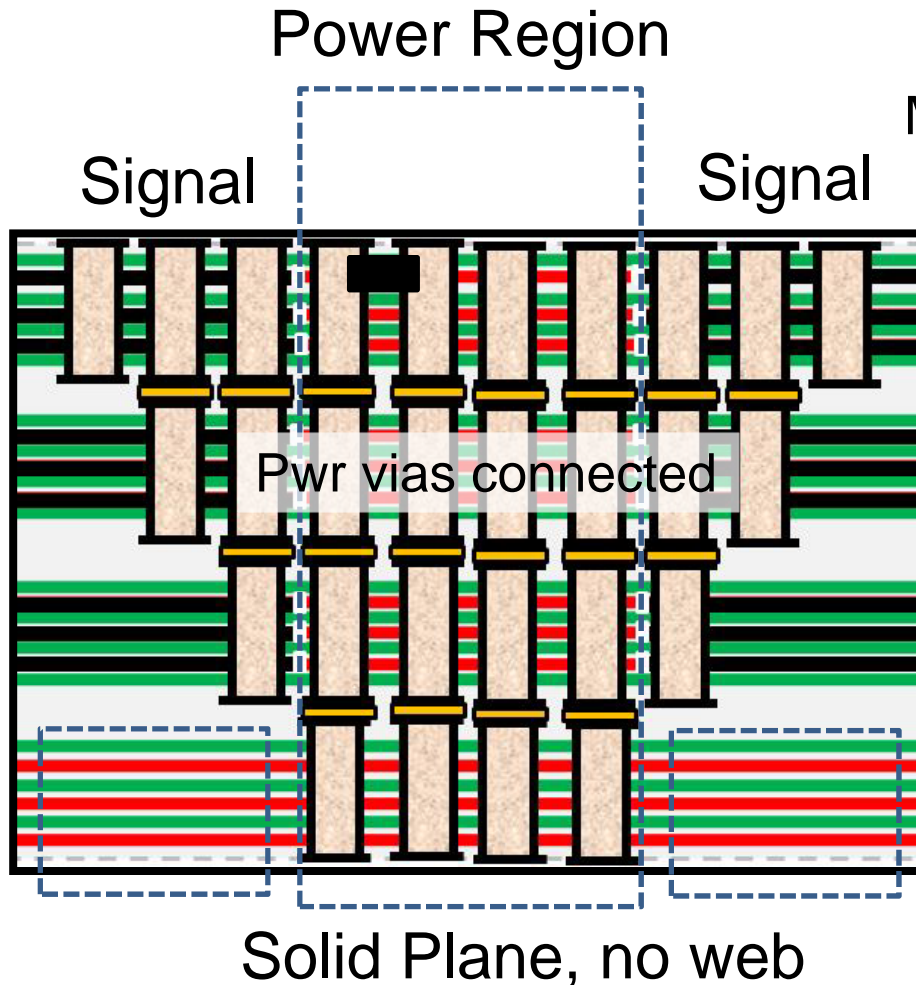
Power Delivery

Two Critical Issues

- **Delivery of High Power in Fine Pitch**
 - Best Configuration depends on Power Pin Location
 - Lowest Inductance Path may no longer be the upper planes in the board.
- **Power Delivery Response to Transient Currents**
 - Power Decoupling to Differential pins mainly influences Common Mode Droop
 - Fmax testing / scan chain Fmax testing

Power Delivery

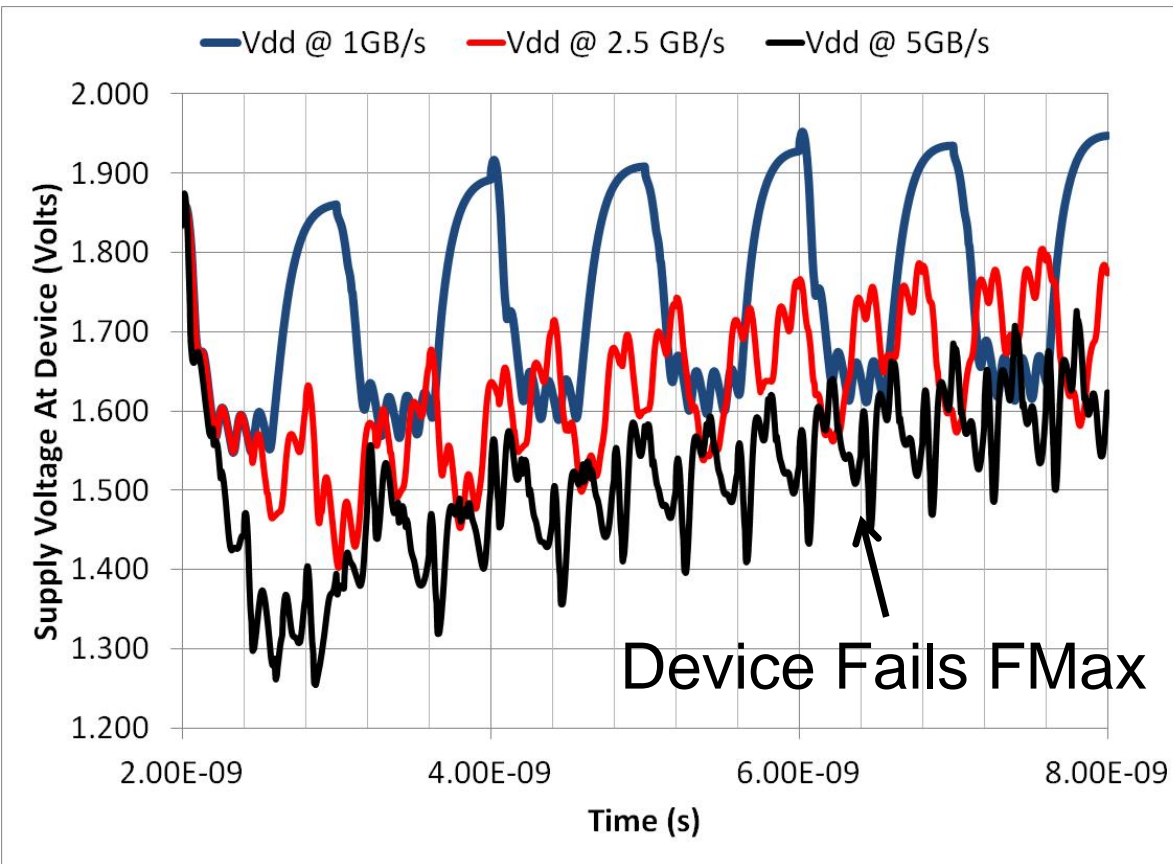
88 amps in 0.4mm pitch
Maximum Safe Point: 150 Amps @ 105 °C



(Flir T620)

Power Delivery

Transient Current: Multi-gate CMOS Chain



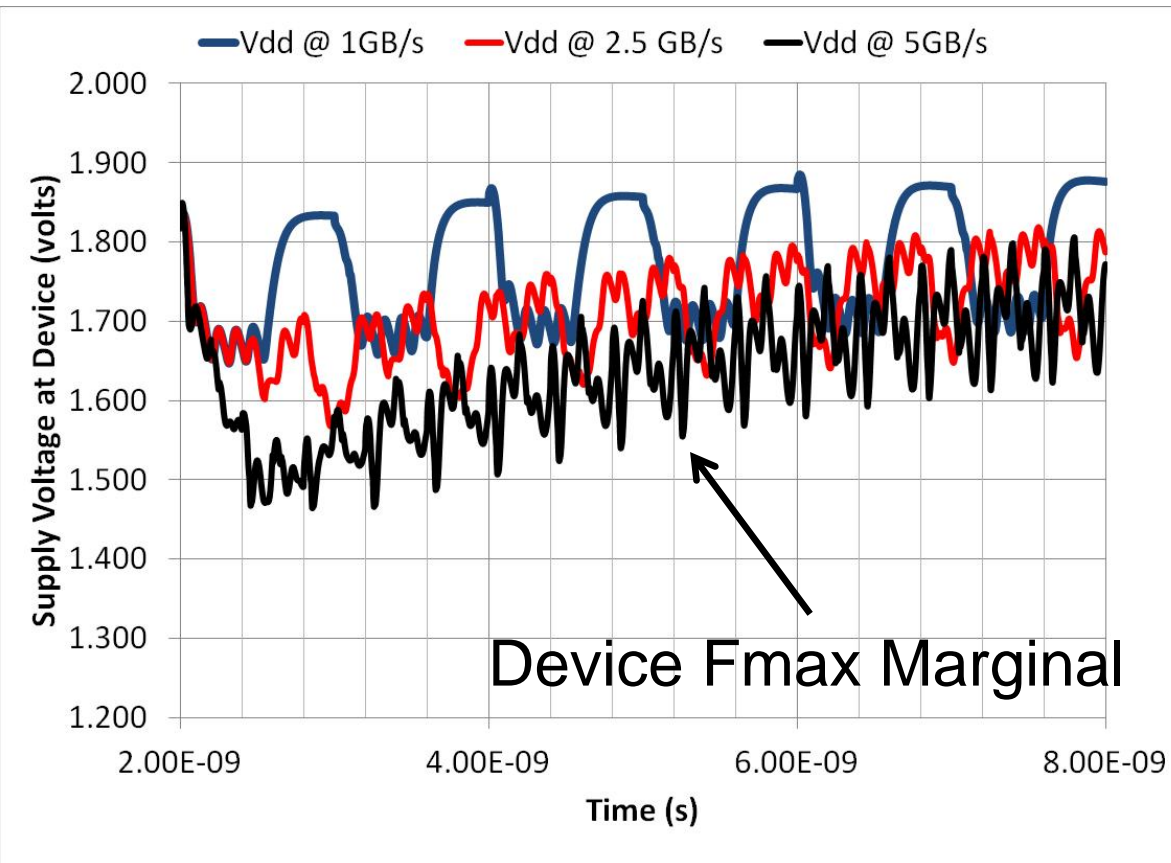
Assumptions:

1. 10+ Million Gates
2. 2.5 million operational / 100 gate chain
3. 80 power pins
4. 320 ground pins
5. 0.95nh socket inductance / pin
6. 1.05 nh board inductance/ pin

Gate Models Courtesy of MOSIS

Power Delivery

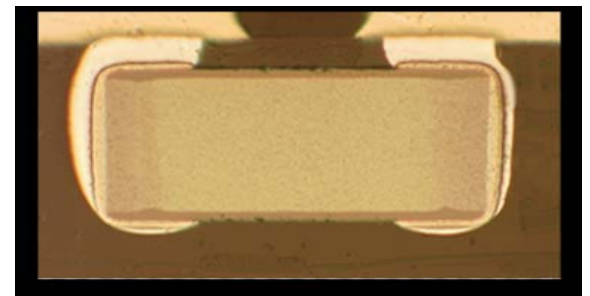
Transient Current: Multi-gate CMOS Chain



Improved Setup:

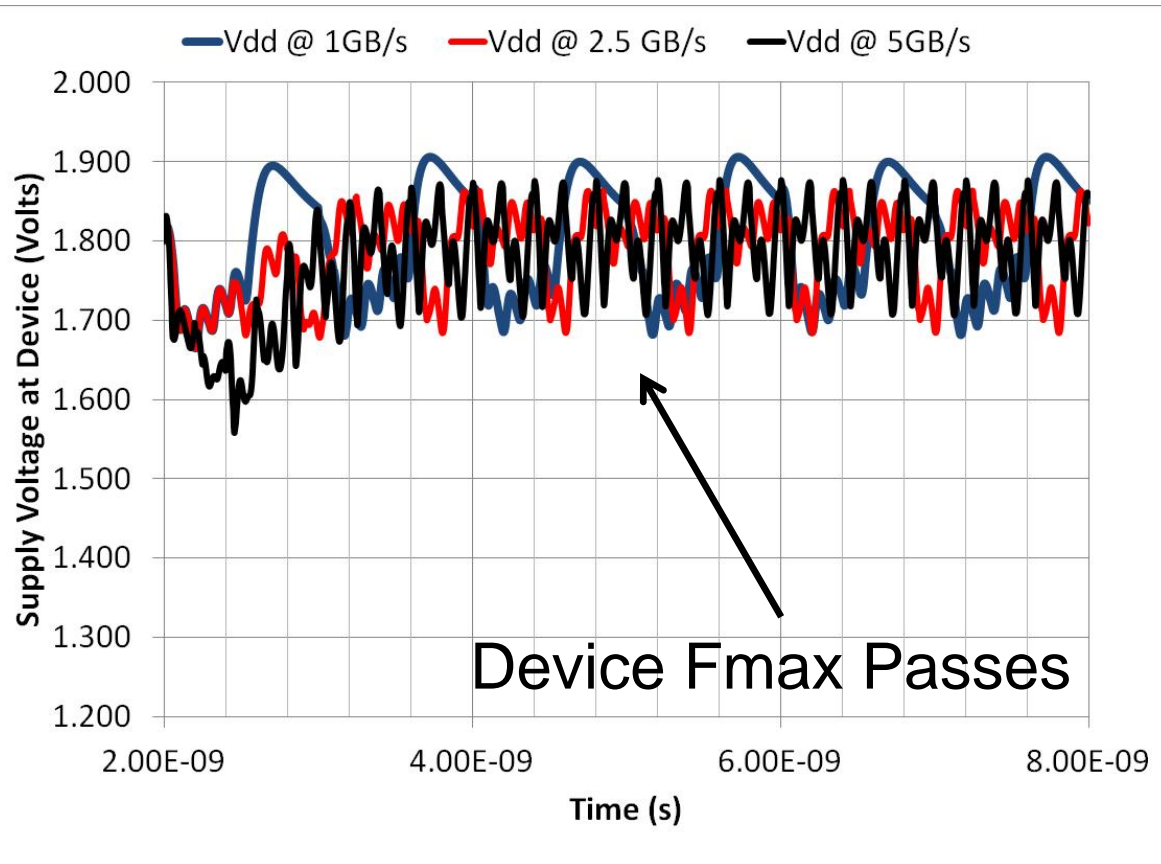
1. Embedded Decoupling

Embedded Capacitor



Power Delivery

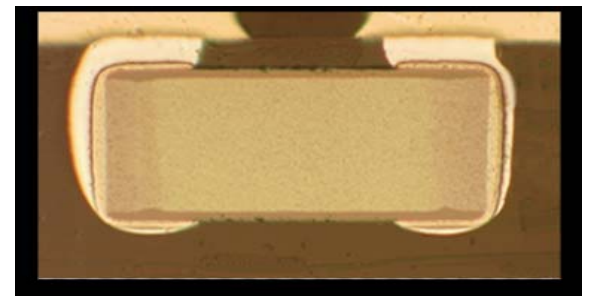
Transient Current: Multi-gate CMOS Chain



Improved Setup:

1. Embedded Decoupling
2. 0.1nh socket inductance / pin

Embedded Capacitor



Concluding Comments

- Socket and loadboard Issues previously ignored must now be considered.
- Critical issues:
 - Maintain a Smooth Loss Curve
 - Via structure
 - Via Entry
 - Socket to Via Path
 - Power Delivery
 - Board to Board / site to site consistency