III. 3 Frequently Asked Questions for Original Equipment Manufacturers: Answers from SUN Microsystems, Inc.

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Current applications with <= .002" P/G cores: Yes

Key driver(s): Reducing dI/dt noise on power planes

Nominal dimensions and tolerances: see below

Benefits: Reduced noise across planes due to lower plane inductance,
reduced radiation,
reduced overall board thickness

Any active (very, ultra, extremely) thin core projects? Yes

Describe: Very thin (.001" cores) being tested in current production parts
Ultra Thin (.0003" cores) have very limited engineering part samples
eXtremely Thin (.00003") have lab samples

Key driver(s): same as above

Perceived benefits: same as above, plus
reducing/eliminating plane resonances

Constraints to implementation:
modeling and verification data
availability;
cost (raw materials)
cost (fabricated)

Dielectric Strength (Withstanding Voltage) Requirement?
250V/mil

Cost budget or tolerance for cost premium:

modest cost premium as an early adopter
expecting cost/value parity after not more than 2 yrs.

Alternatives: Use different system partitioning to reduce the amount of high-speed current entering the PCB planes: reduce current/line, reduce number of lines simultaneously switching, increase transition time, divert current from entering PCB planes by using capacitors on silicon and/or package

List desired physical attributes:

large panel form (=> 18 x 24")
copper clad thickness options
thickness range one-sided: thickness not to exceed .001". etc.

List desired electrical attributes:

Low inductance,
resonance-free self-impedance,
low-pass transfer impedance

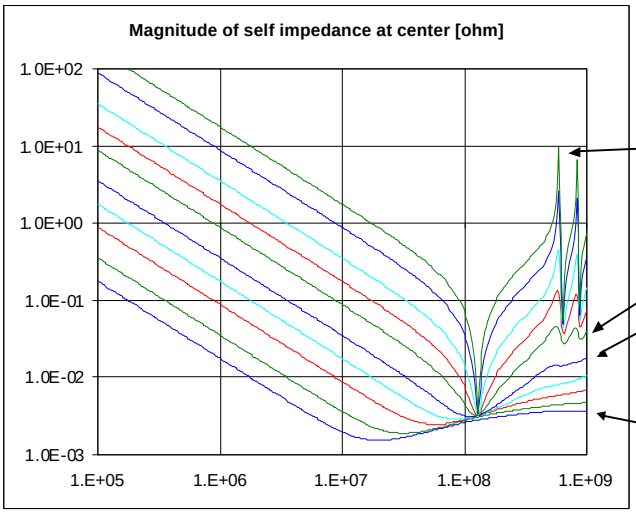
If available, within cost budget, use would be: Pervasive

Schedule; desired time to:	.001"	.0003"
Samples / Eng/ Verification:	Now	Now
Proto-Circuits:	Now	6 - 9 months
Volume Circuits:	6 months	12 - 15 months

Thin Laminate Electrical Benefits

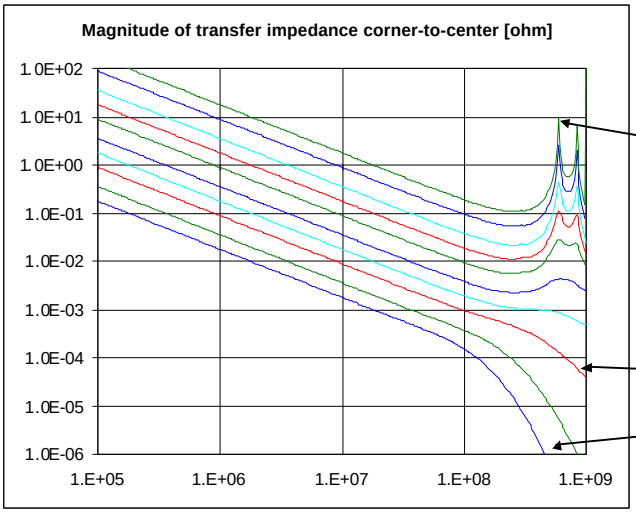
- Inductance (L) is proportional to thickness (t)
- dV=L*dI/dt: SSN is less if L is lower
- Plane resonances are suppressed if t<0.3 mils
- Low-pass noise propagation if t<1um
- Radiation is less from thinner laminates
- Dielectric constant increases static capacitance, but L is unchanged

Resonance-Free Planes for t<0.3mils



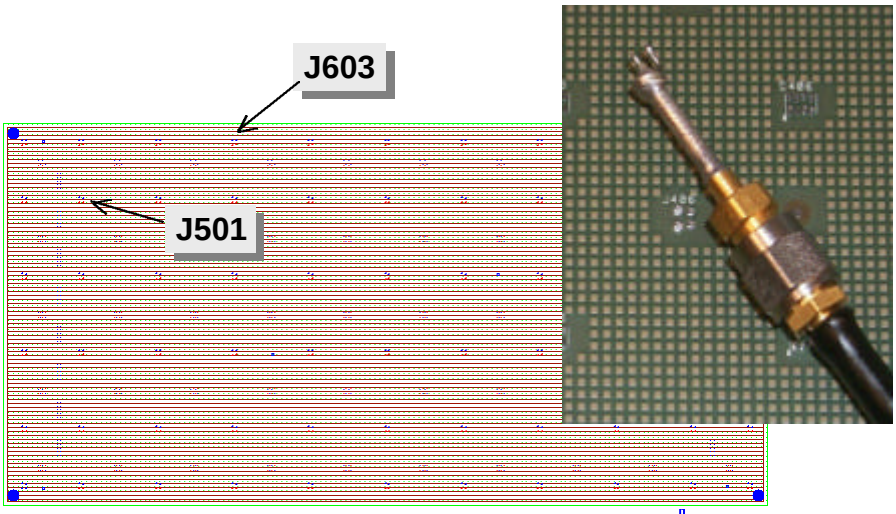
10”x10” planes
Bare board
Simulated, t=
- 10-mil
- 5-mil
- 2-mil
- 1-mil
- 0.5-mil
- 0.2-mil
- 0.1-mil
- 0.05-mil
- 0.02-mil
- 0.01-mil

Low-pass Transfer for t<1um

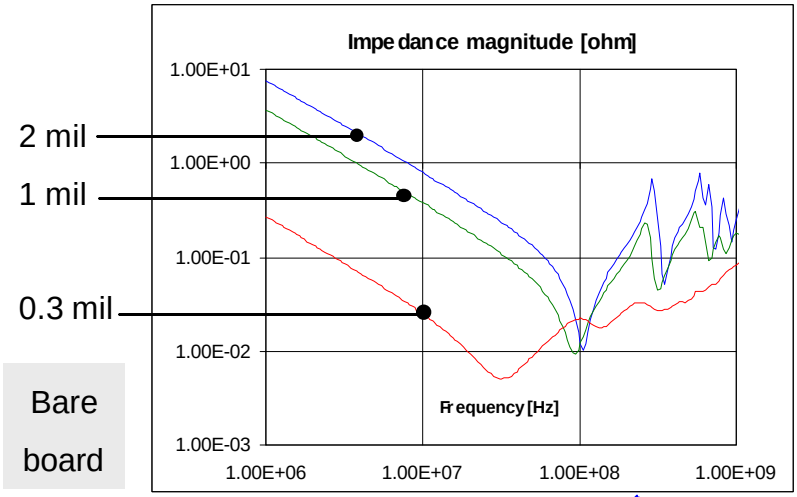


10”x10” planes
Bare board
Simulated, t=
- 10-mil
- 5-mil
- 2-mil
- 1-mil
- 0.5-mil
- 0.2-mil
- 0.1-mil
- 0.05-mil (1.2um)
- 0.02-mil
- 0.01-mil

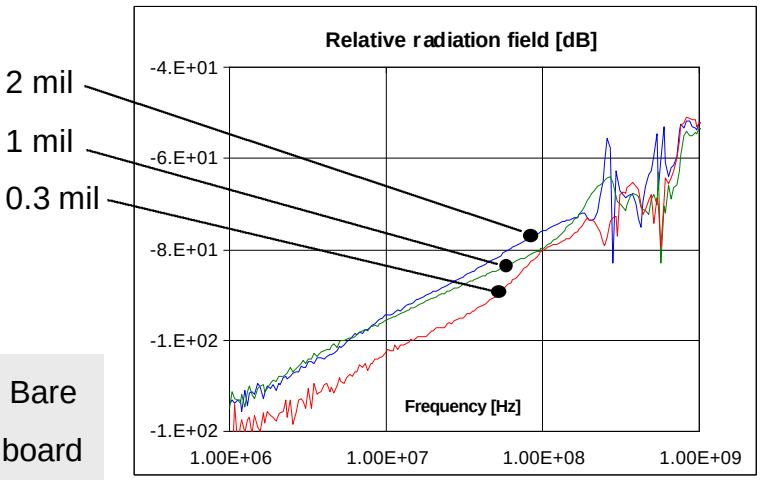
10”x5” Test Board



Measured Self Impedance

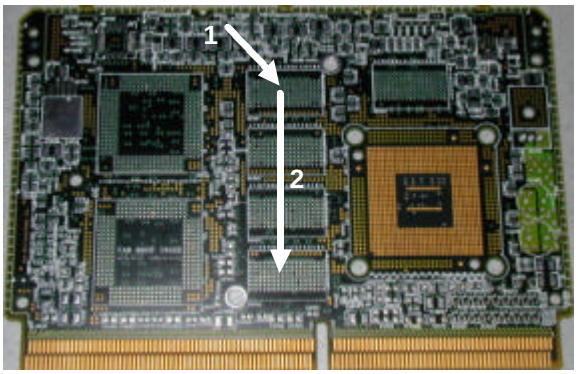


Measured Close-Field Radiation



Impedance on Small Board

Geometry



Paralleled plane pairs

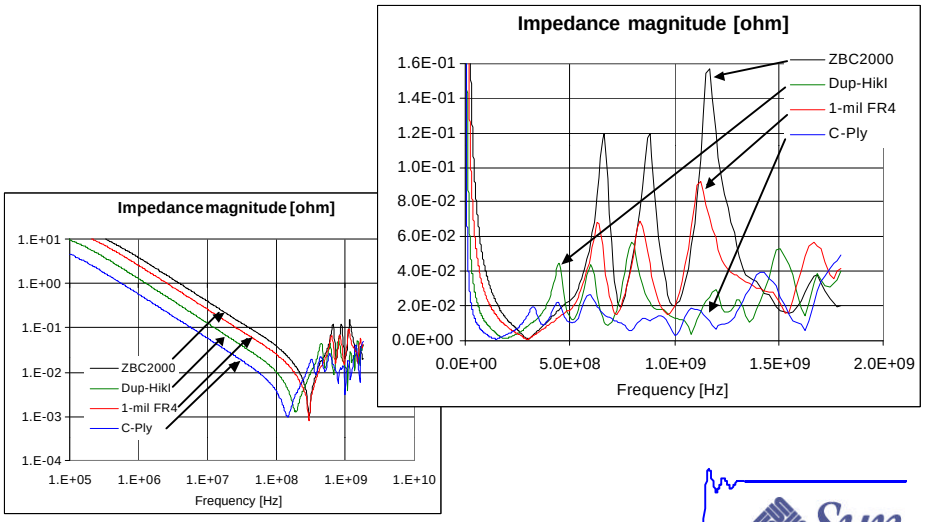
Bare board

Same construction, with

- Aromat 2-mil FR4 BC2000
- DuPont 1-mil HiK
- Aromat 1-mil FR4
- 3M 0.3-mil C-Ply

Impedance on Small Board

Self-impedance at (1)



Impedance on Small Board

Transfer-impedance (2)