UBM

Reducing Noise in Power Distribution Networks On time and In Budget

Steve Sandler, (Picotest)

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So, What is noise

noise

[noiz]

NOUN

1. a sound, especially one that is loud or unpleasant or that causes disturbance:
   "making a noise like a pig in a trough"
   synonyms: sound · din · hubbub · clamor · racket · uproar · tumult · [more]

2. technical
   irregular fluctuations that accompany a transmitted electrical signal but are not part of it and tend to obscure it.

VERB

1. dated (be noised about)
   talk about or make known publicly:
   "you've discovered something that should not be noised about"

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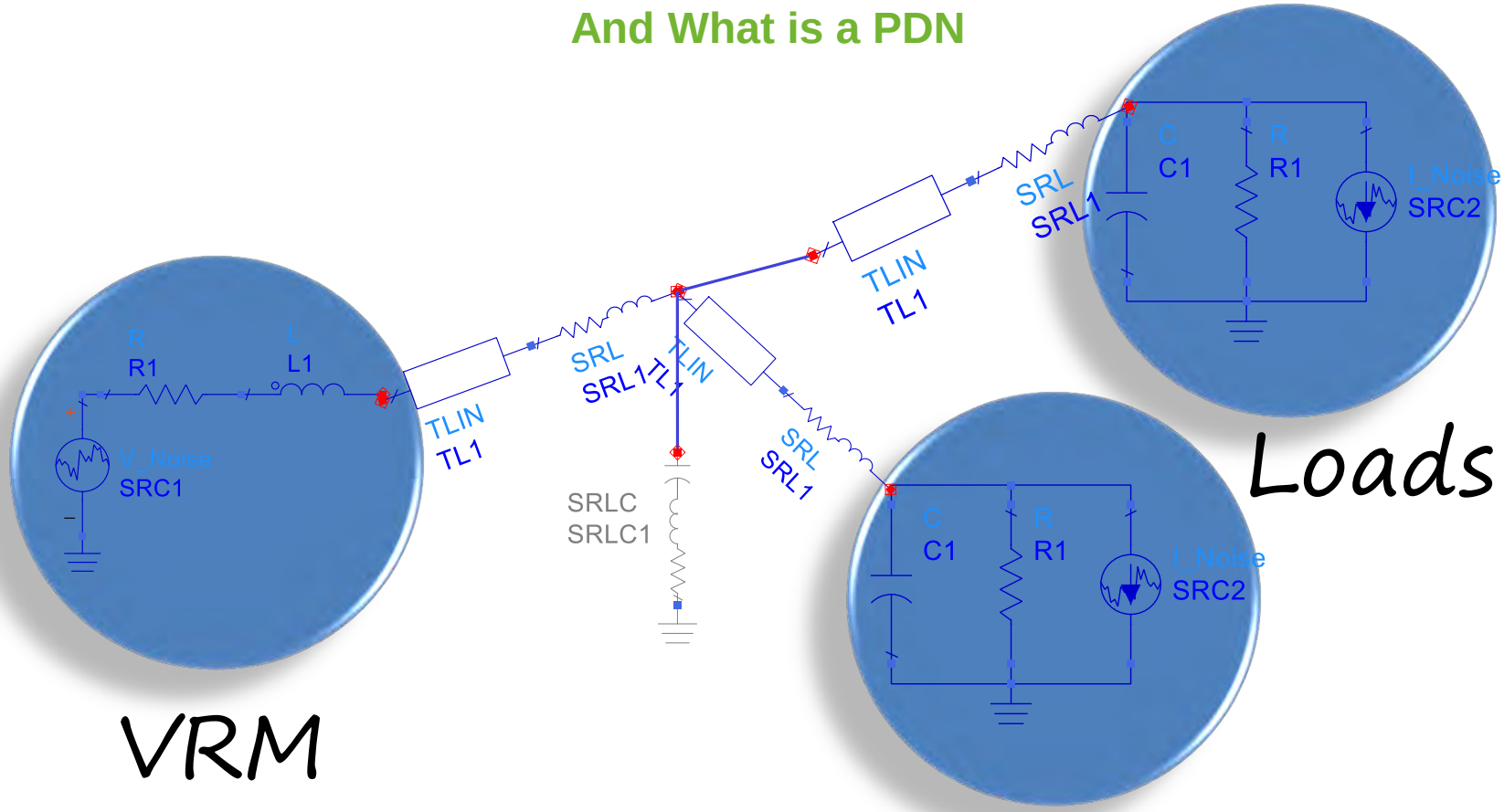
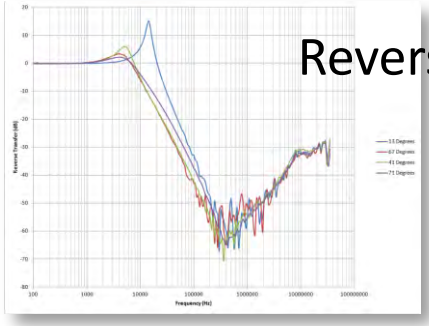
And What is a PDN

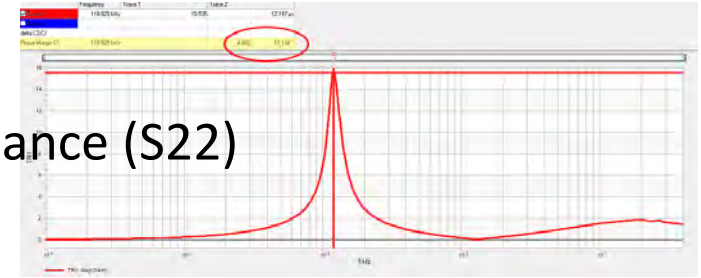


A VRM is a Noise Hub

Reverse (S12)

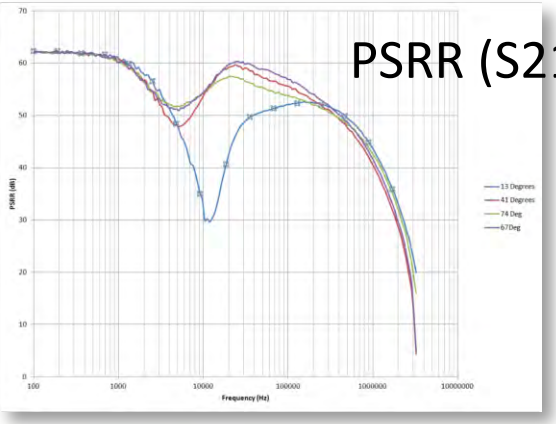


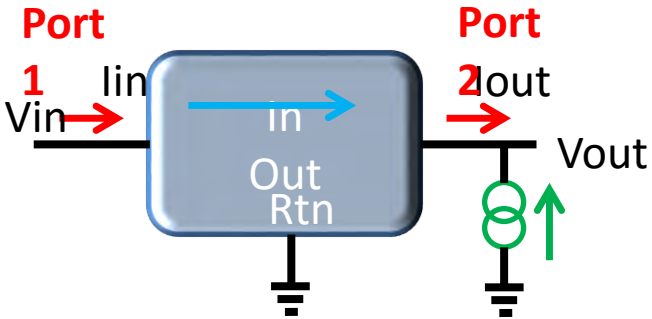
Output Impedance (S22)



Input impedance (S11)

PSRR (S21)

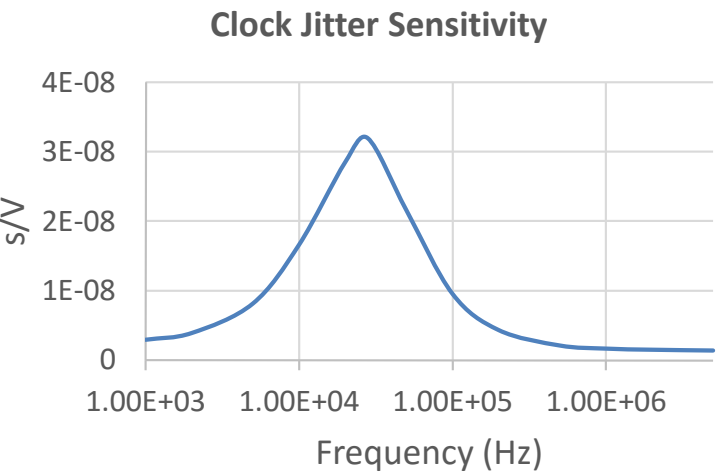


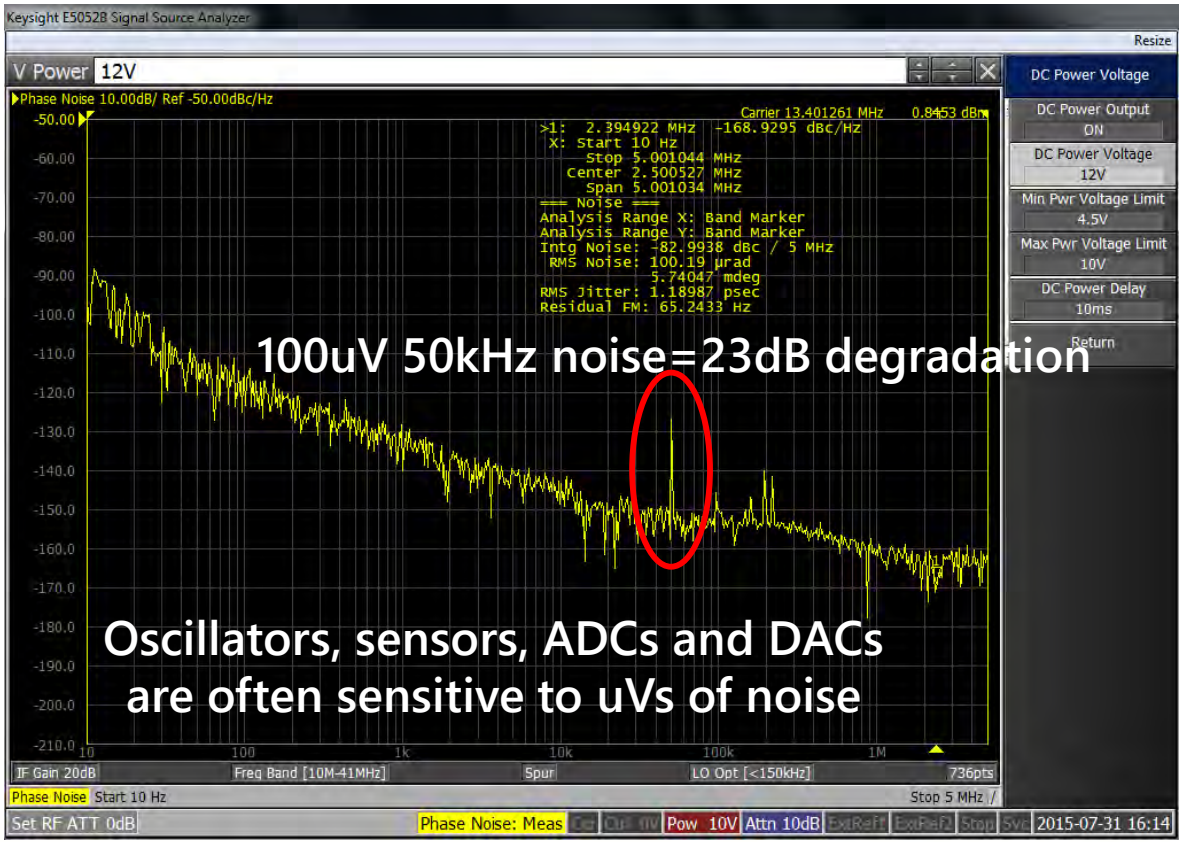


Output noise/spikes (S22)

Know Your Loads

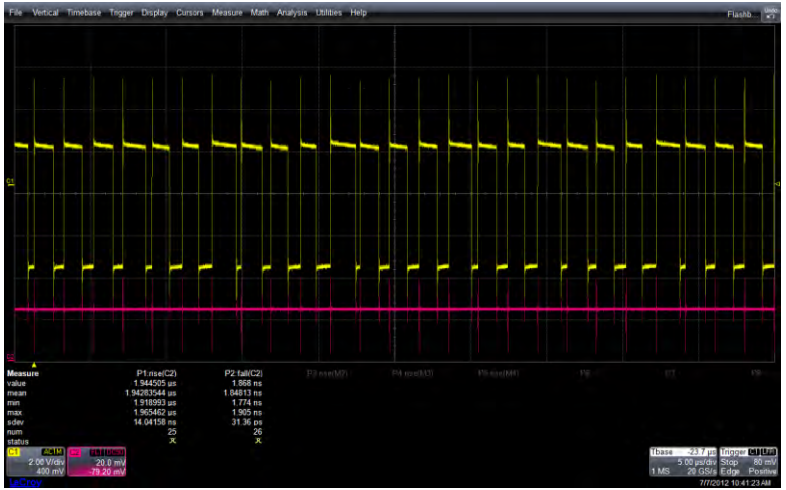
What can they tolerate and what can't they tolerate

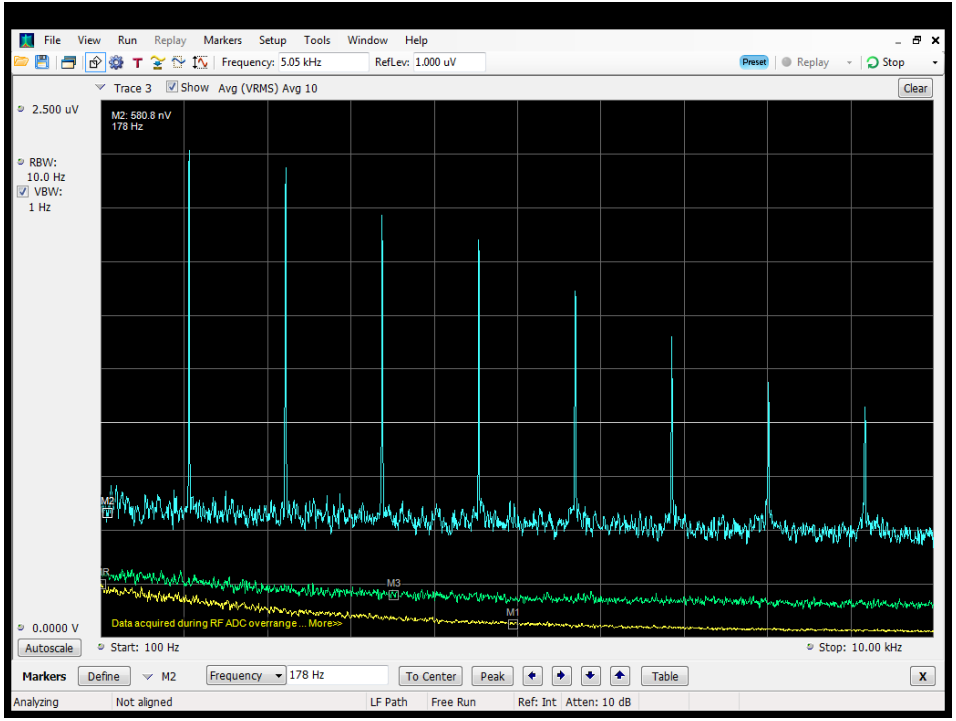




And Your VRMs

Linear Regulators and LDO's are not the same, though either can have spurs!

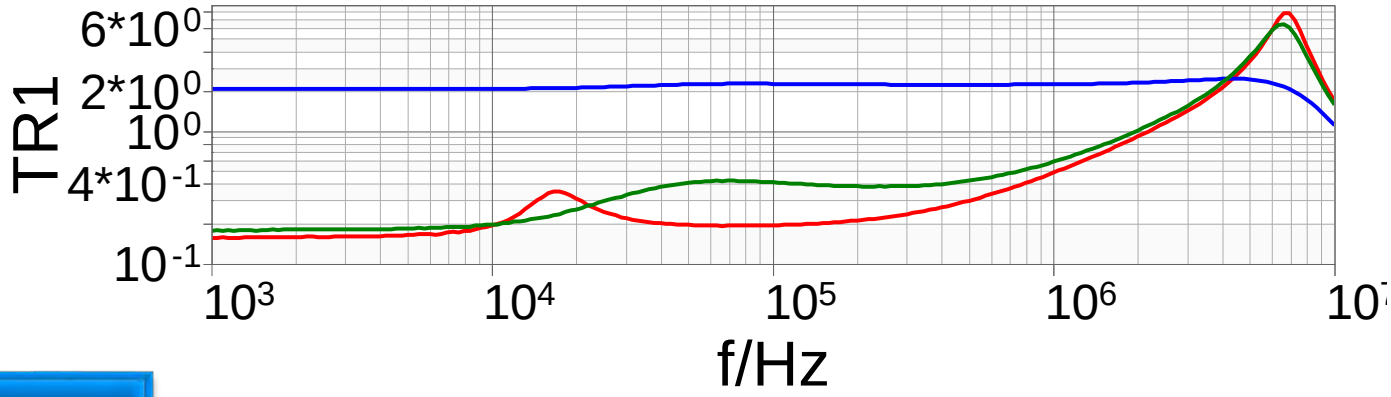




Switching regulators can modulate generating low frequency noise

Set and Maintain Goldilocks Impedance

- Not too low
- Not too high
- Just right ☺

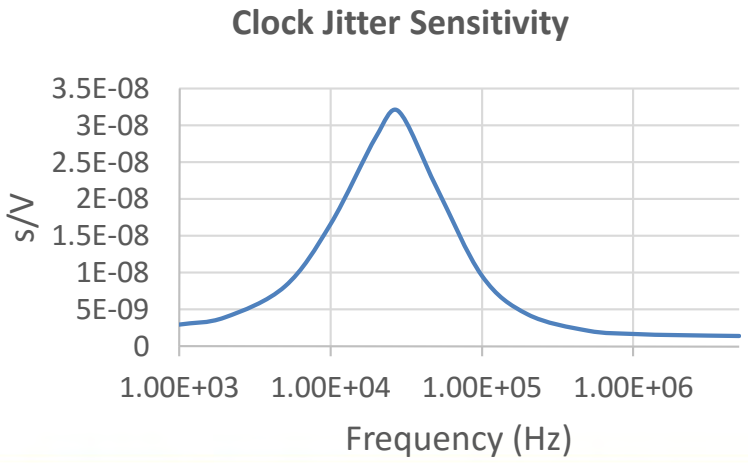


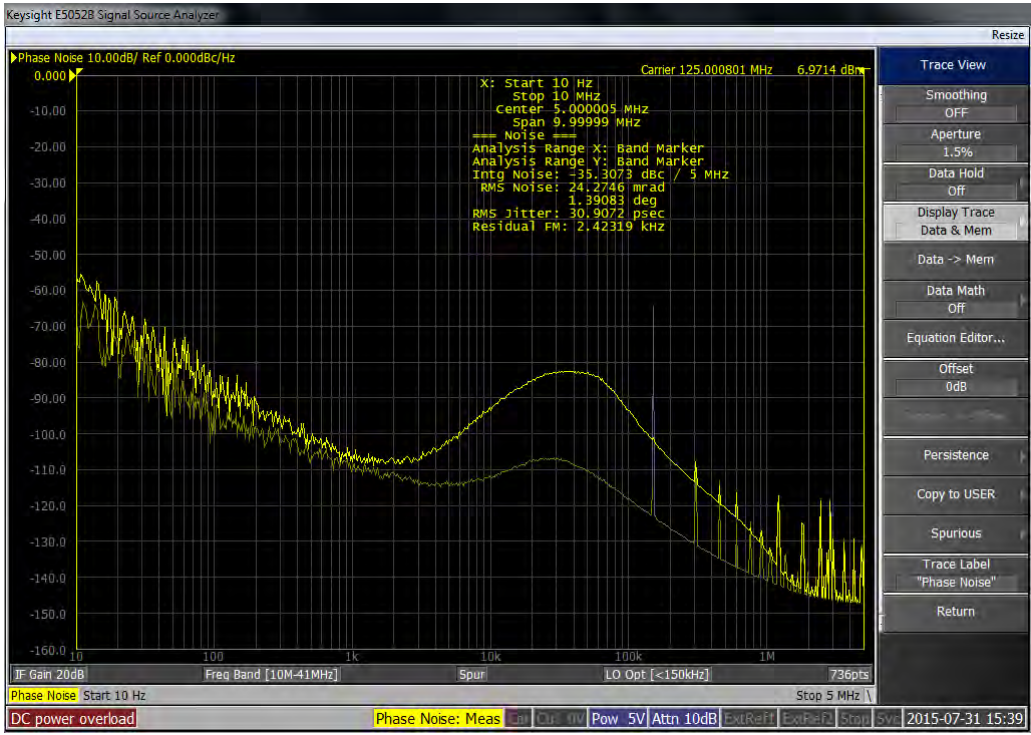
$$C = \frac{L}{Z^2_{desired}}$$

- Setting impedance too high results in noise
- Too low results in resonances or excessive (expensive) capacitance
- Moving regulators closer to the load reduces L

Spend Most of Your Time Evaluating NOT Designing

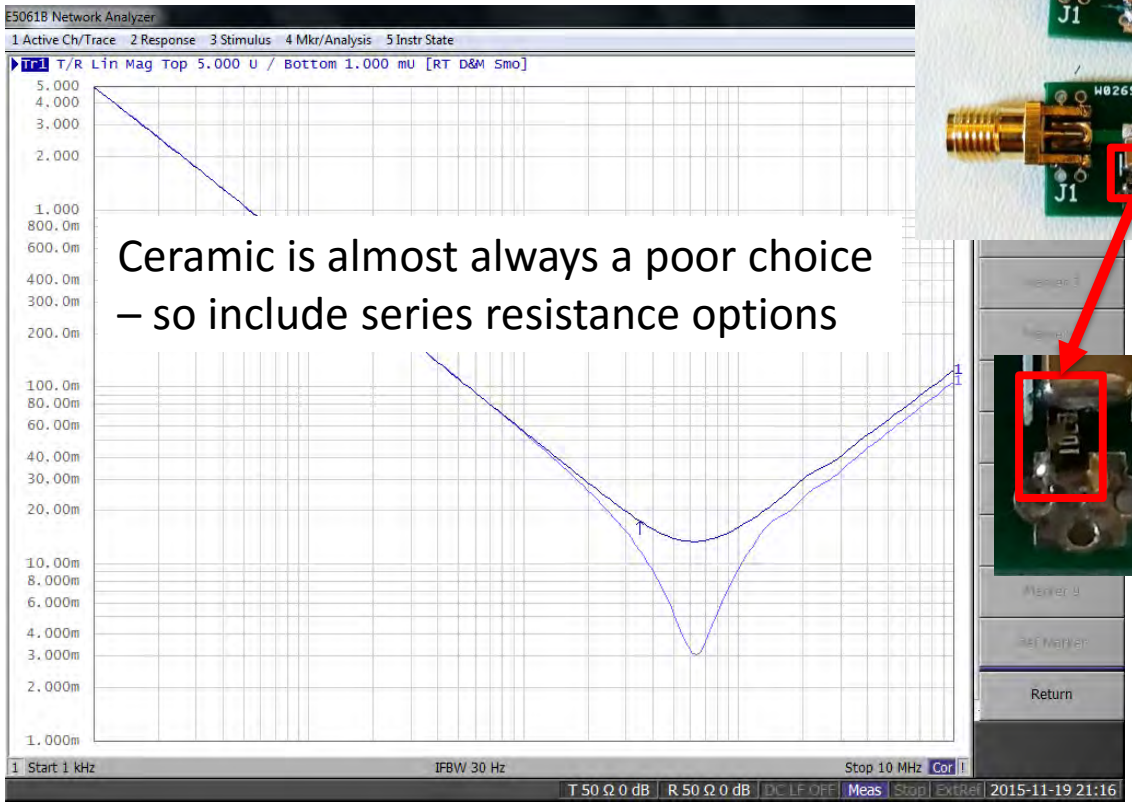
If you selected a clock with high sensitivity at 30kHz (??) don't choose a regulator with high impedance at 30kHz!



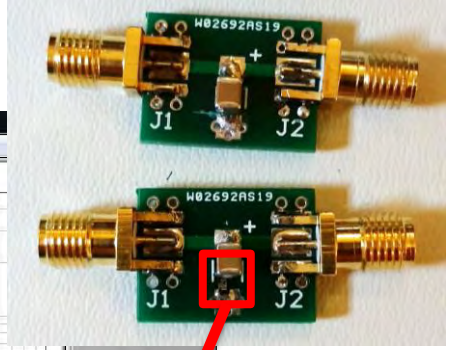


Choose Components Wisely

New components are like a box of cracker Jacks – SURPRISE INSIDE



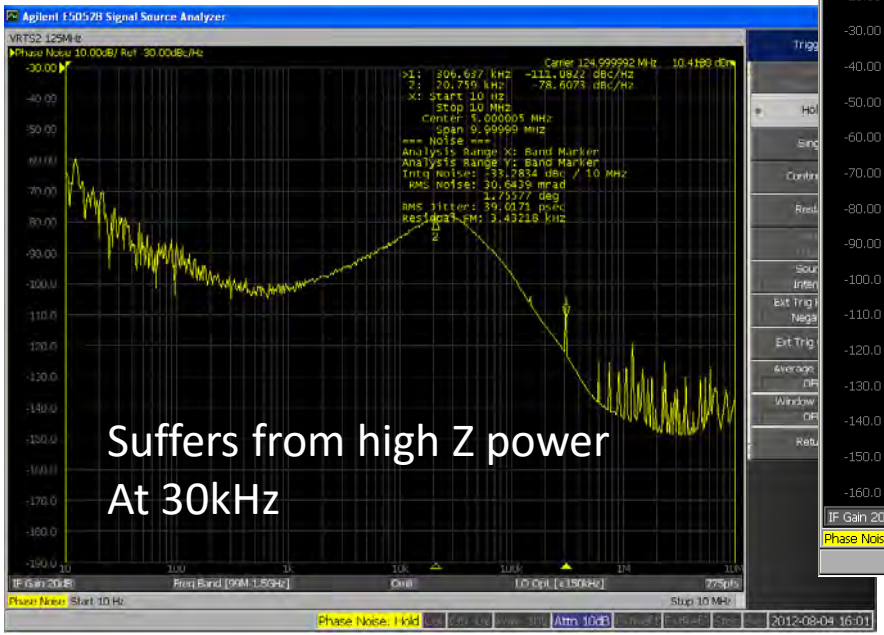
Ceramic is almost always a poor choice – so include series resistance options

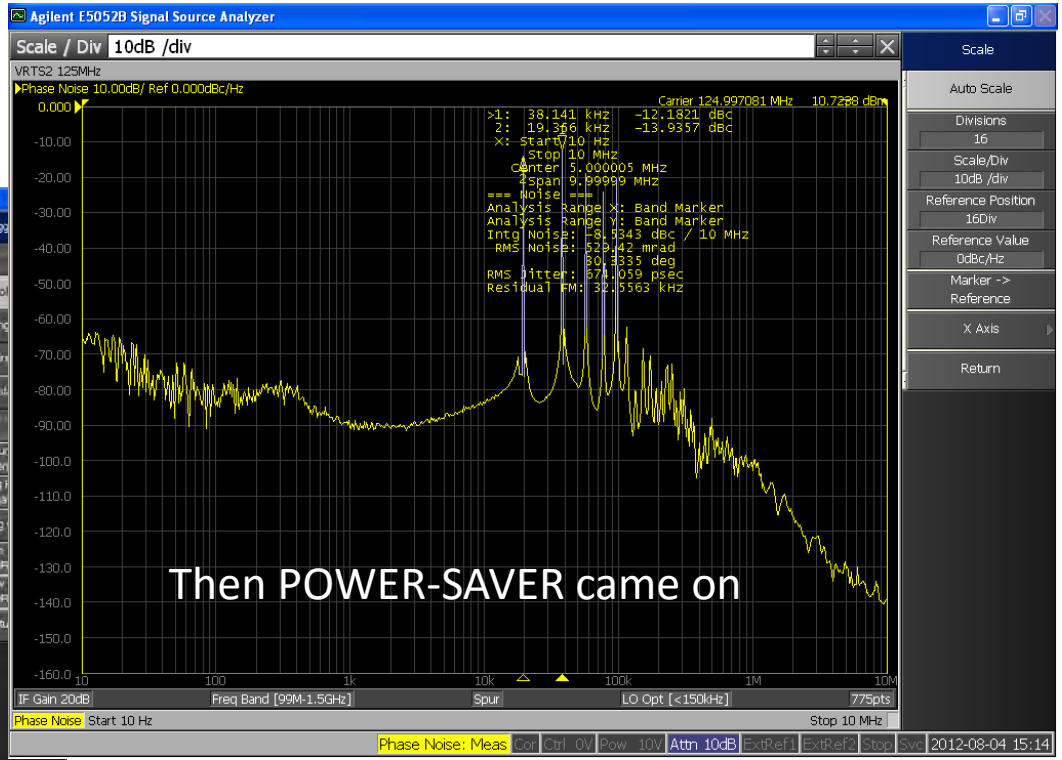


10mΩ

Consider the Unexpected

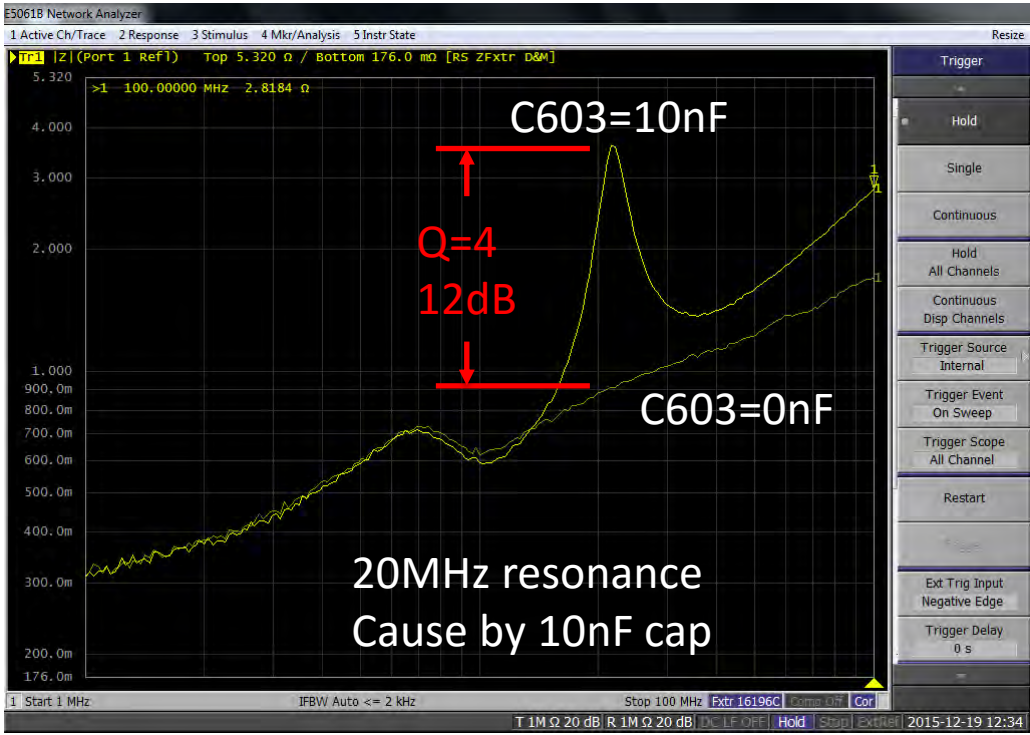
OOPS happens!





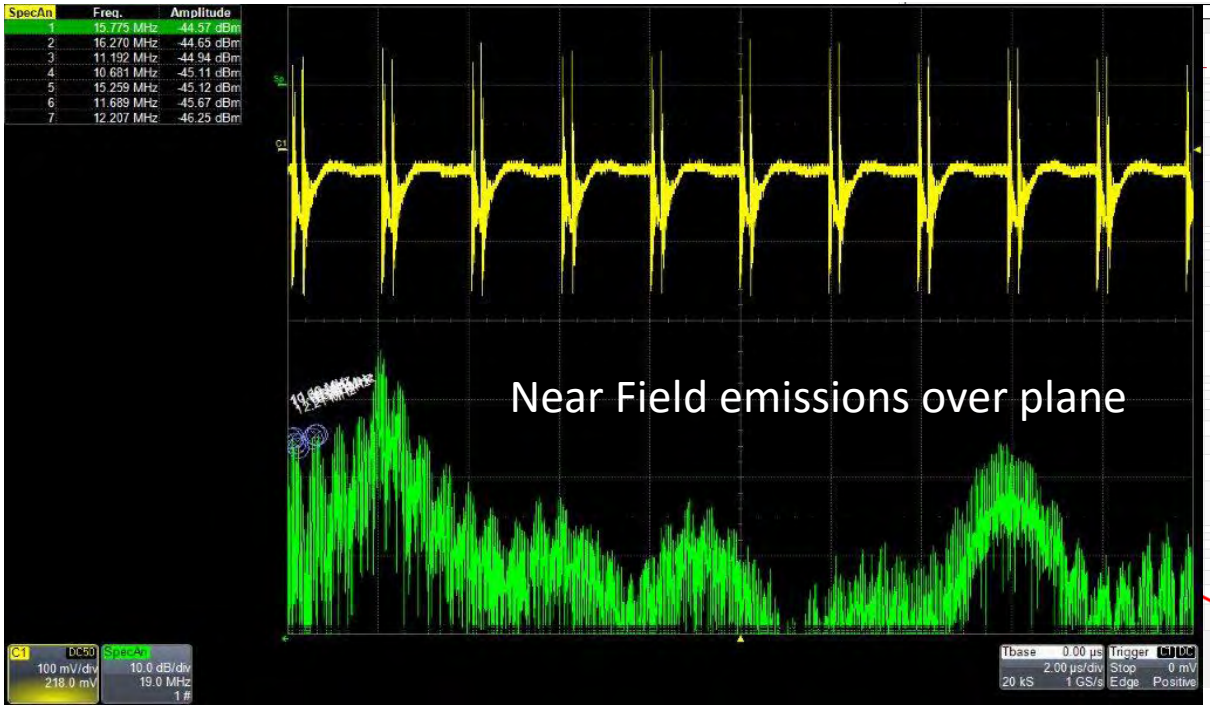
Think RF/uWave – PCB Simulation is Important

Capacitors and PCB's can easily form a resonator

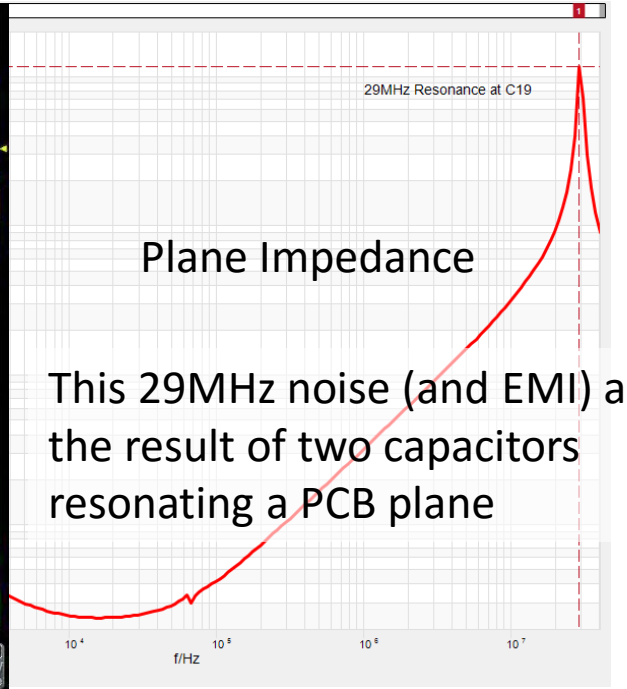


Troubleshoot Efficiently

Two domains are better than one and three are better than 2



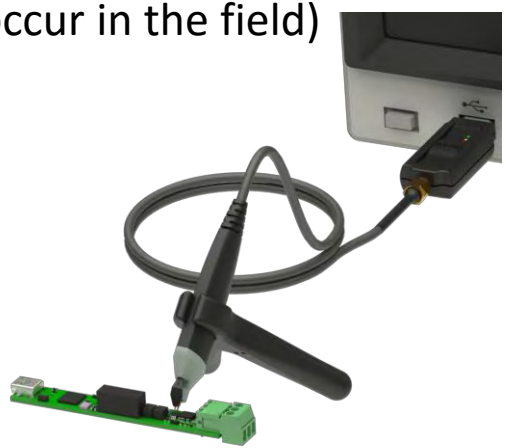
Near Field emissions over plane



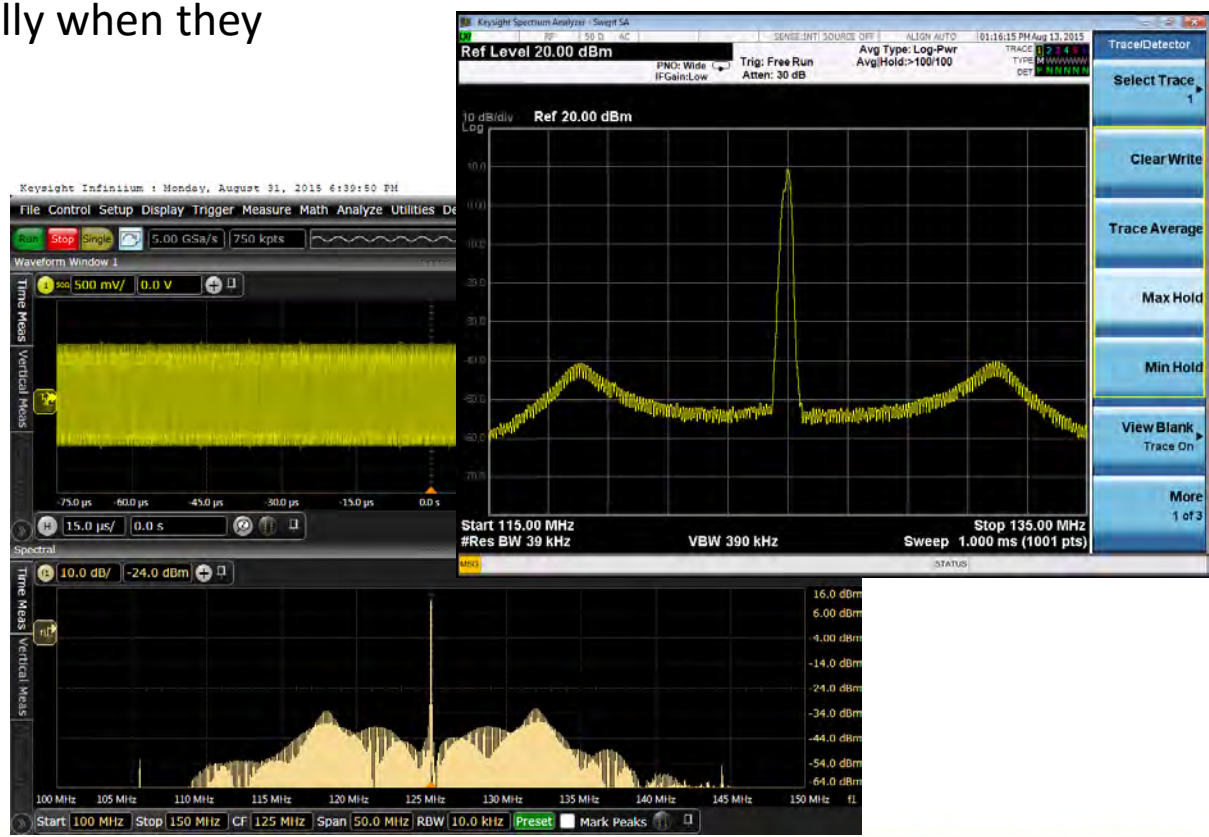
This 29MHz noise (and EMI) are the result of two capacitors resonating a PCB plane

Interrogate your PDN Even if It Looks OK

Nobody likes surprises (especially when they occur in the field)



A wideband harmonic comb and browser probe can quickly identify PDN soft spots between 1kHz and more than 1GHz



Summary

1. Set impedance wisely and keep it flat
2. Spend more time evaluating and less time “designing”
3. Prepare for the unexpected
4. Troubleshoot efficiently
5. Interrogate to identify weak or sensitive spots

Thank You!

Thanks for Attending!

Keysight CERTIFIED EXPERT EDA SOFTWARE

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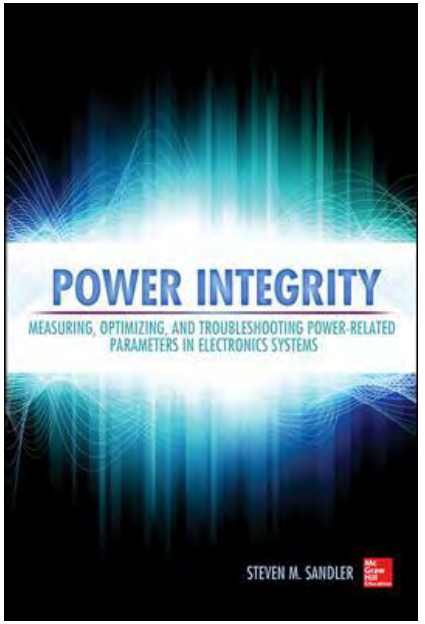
Steve Sandler has been involved with power system engineering for more than 37 years. Steve is the founder of of PICOTEST.com, a company specializing in accessories for high performance power system and distributed system testing.

He frequently lectures and leads workshops internationally on the topics of power, PDN and distributed systems. He is also the other of Power Integrity – from McGraw-Hill

He was also the recipient of the ACE 2015 Jim Williams Contributor of the Year ACE Award for his outstanding and continuing contributions to the engineering industry and knowledge sharing.



Contact me through our LinkedIn group – Power Integrity for Distributed Systems – or email me at Steve@Picotest.com