

Ultimetrix

Power Delivery Network Analysis

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Agenda

- Power Delivery Challenges
- Measurement Approach
- Power Delivery Network Analyzer
- Measurement Examples

Power Delivery Challenges

Higher Density

Faster Switching Speeds

Higher Current

Higher Power Dissipation

Lower Voltage

Lower Voltage Noise Margin

Lower PDN Impedances

Wider Bandwidth

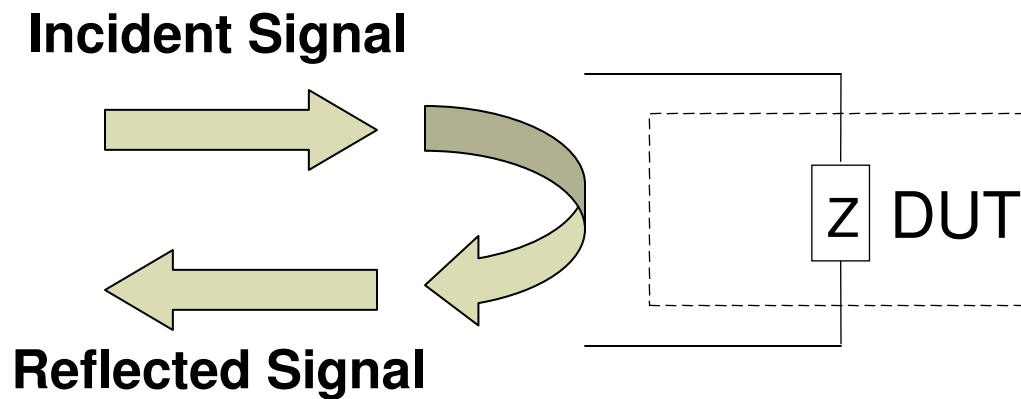
Example DUT's

- Networks
 - PCB PDN
 - IC Package PDN
- Components
 - Capacitors
 - Transformers
 - Voltage Regulator Modules

Typical Target Ranges

- Target Shunt Impedance
 - Approximately $1\text{m}\Omega$
- Measurement Frequency:
 - VRM: DC to 100KHz
 - PCB: 1KHz to 40MHz
 - IC Package: 1MHz to 3GHz

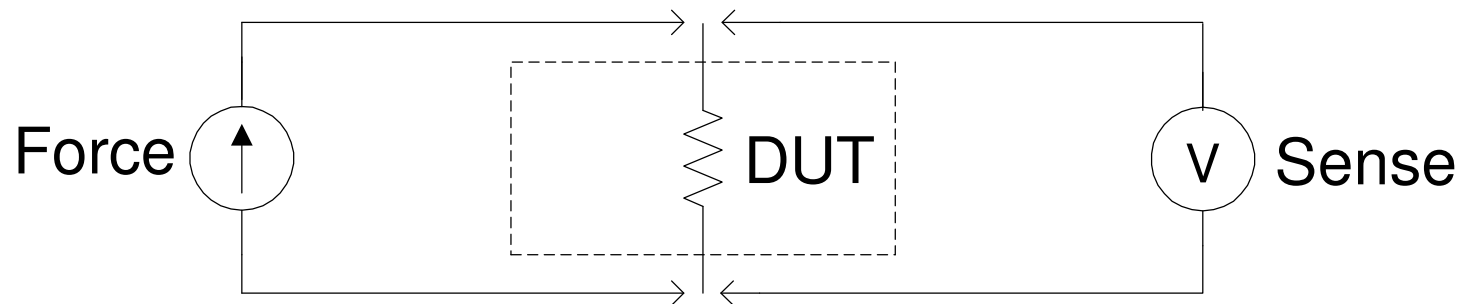
Reflection Measurement



$$Z=f(\Gamma)$$

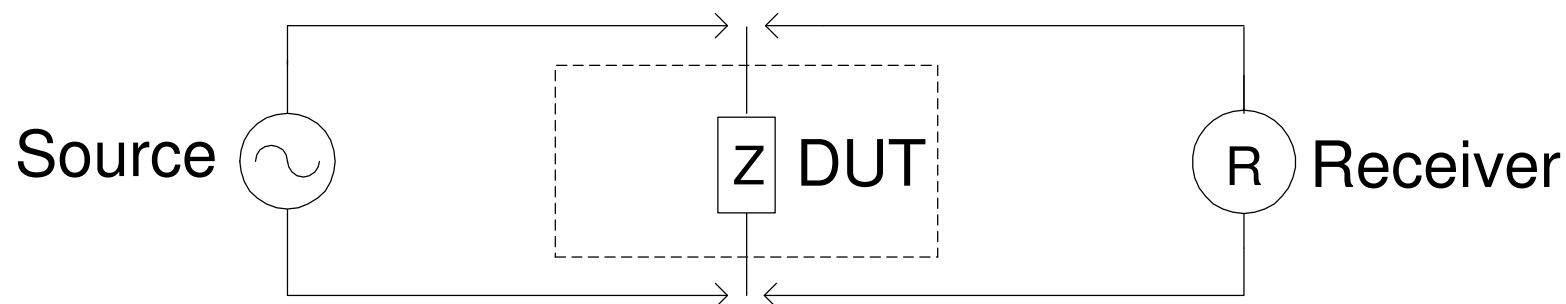
Kelvin Technique

4-Point DC Resistance Measurement Technique

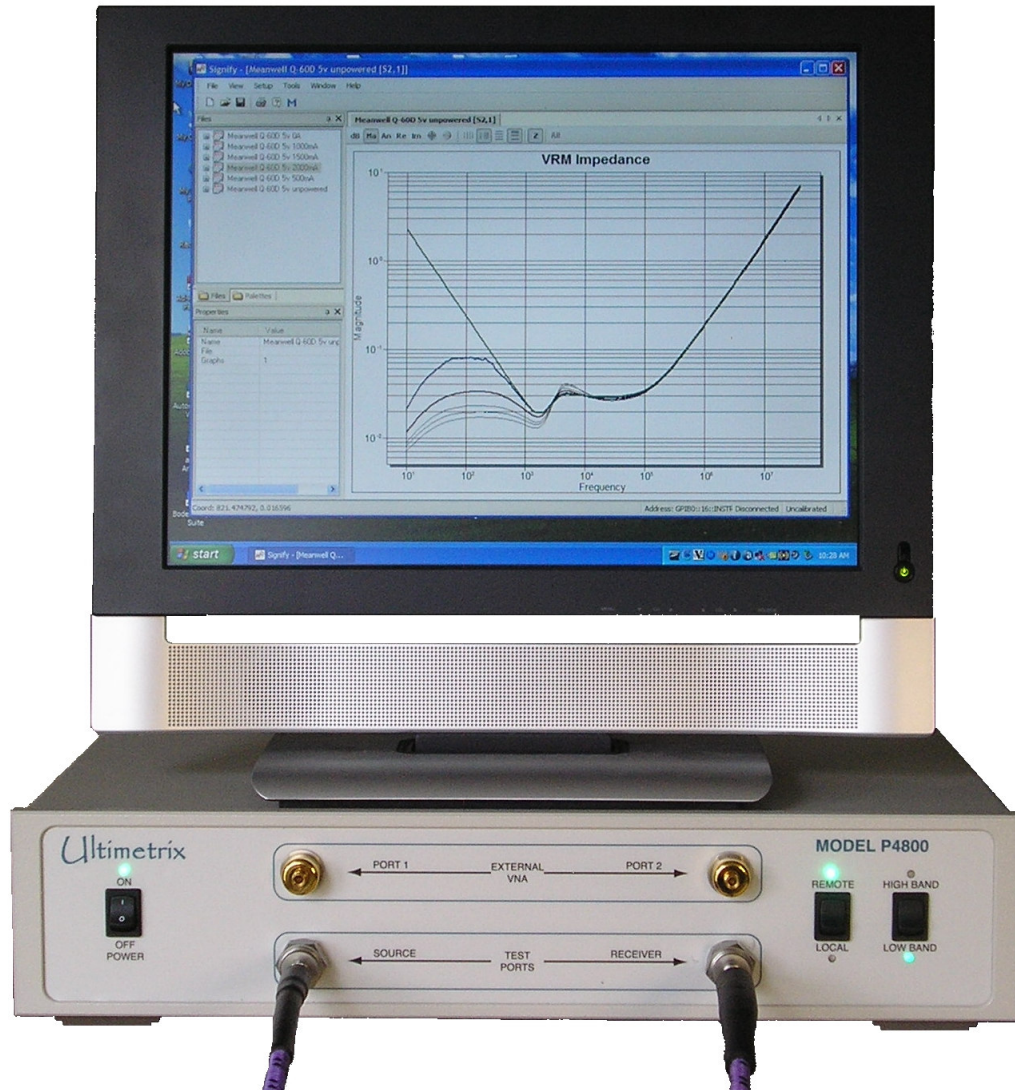


RF Measurement Approach

4-Point RF Impedance Measurement Technique Shunt Impedances



P4800 System Configuration



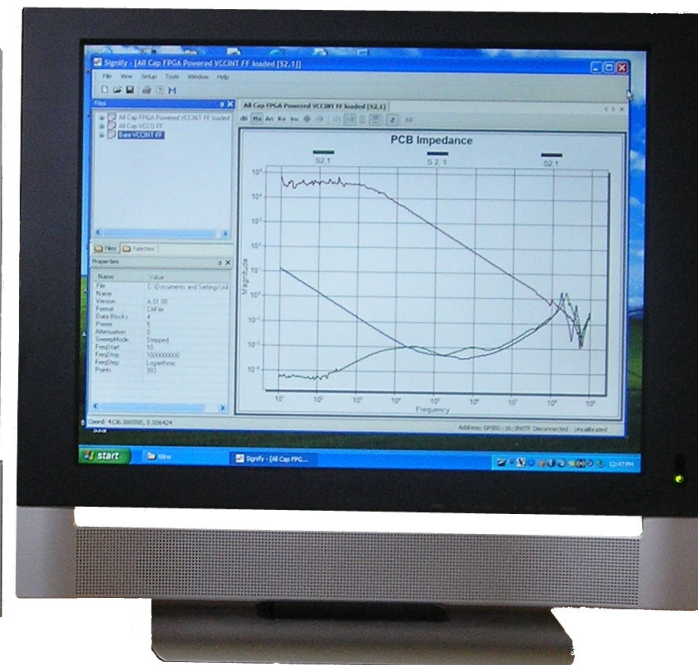
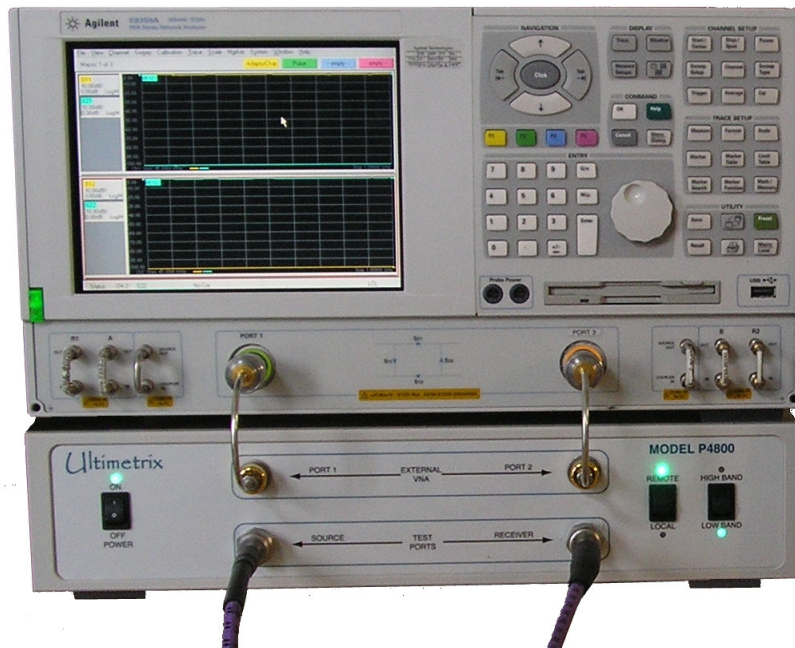
**Frequency Range:
10Hz to 40MHz**

USB Connection to PC

P4800 With Optional VNA

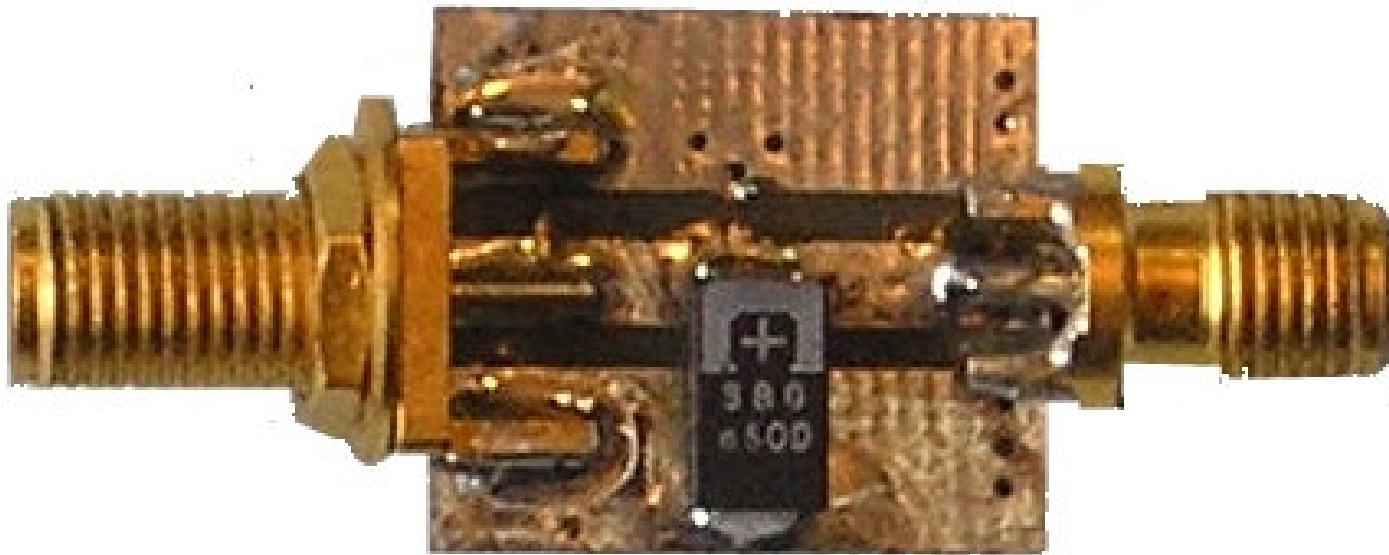
**Frequency Range:
10Hz to 18GHz**

**USB Connection to PC
GPIB-USB from VNA to P4800**

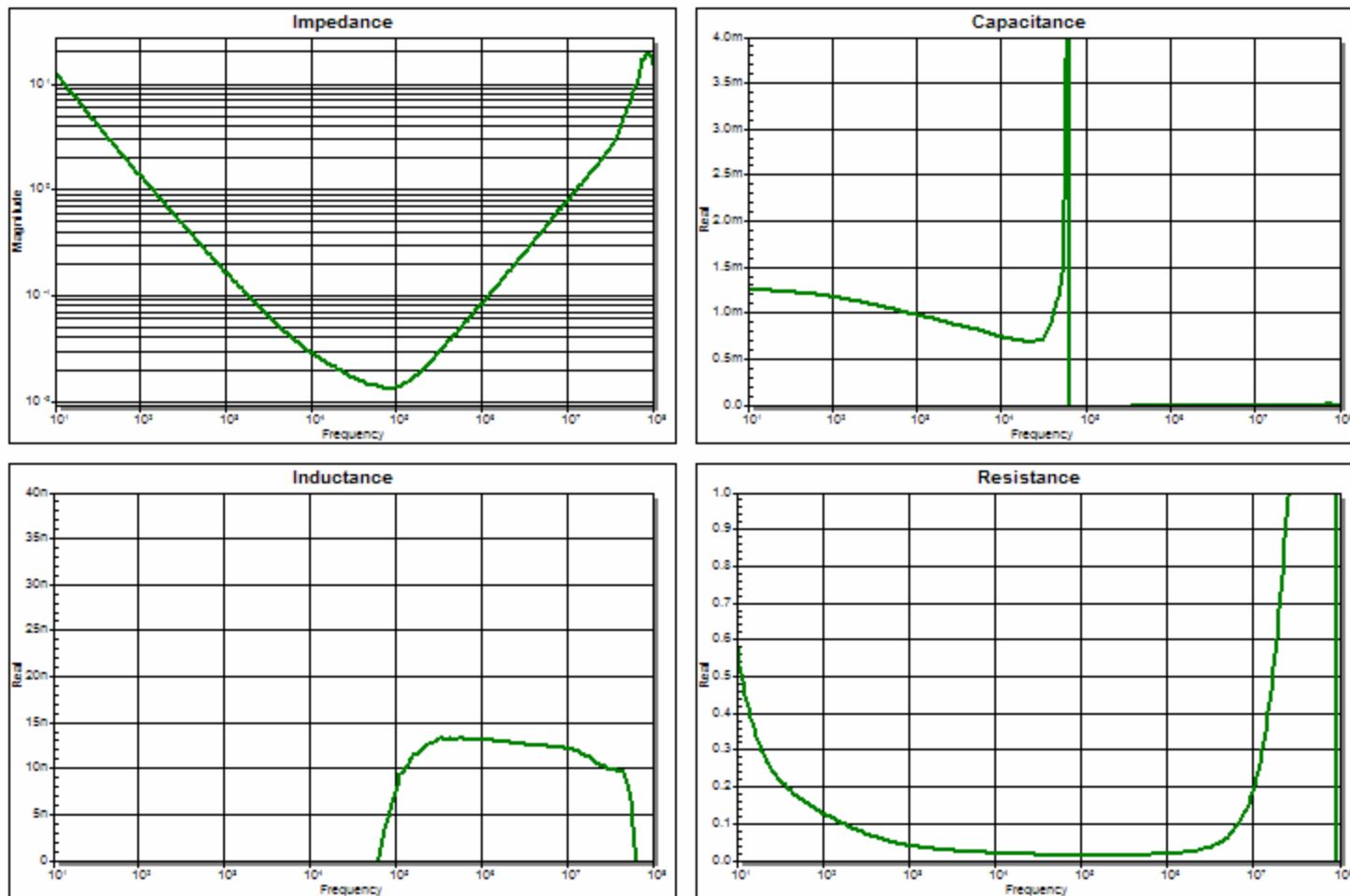


Capacitor Measurement Example

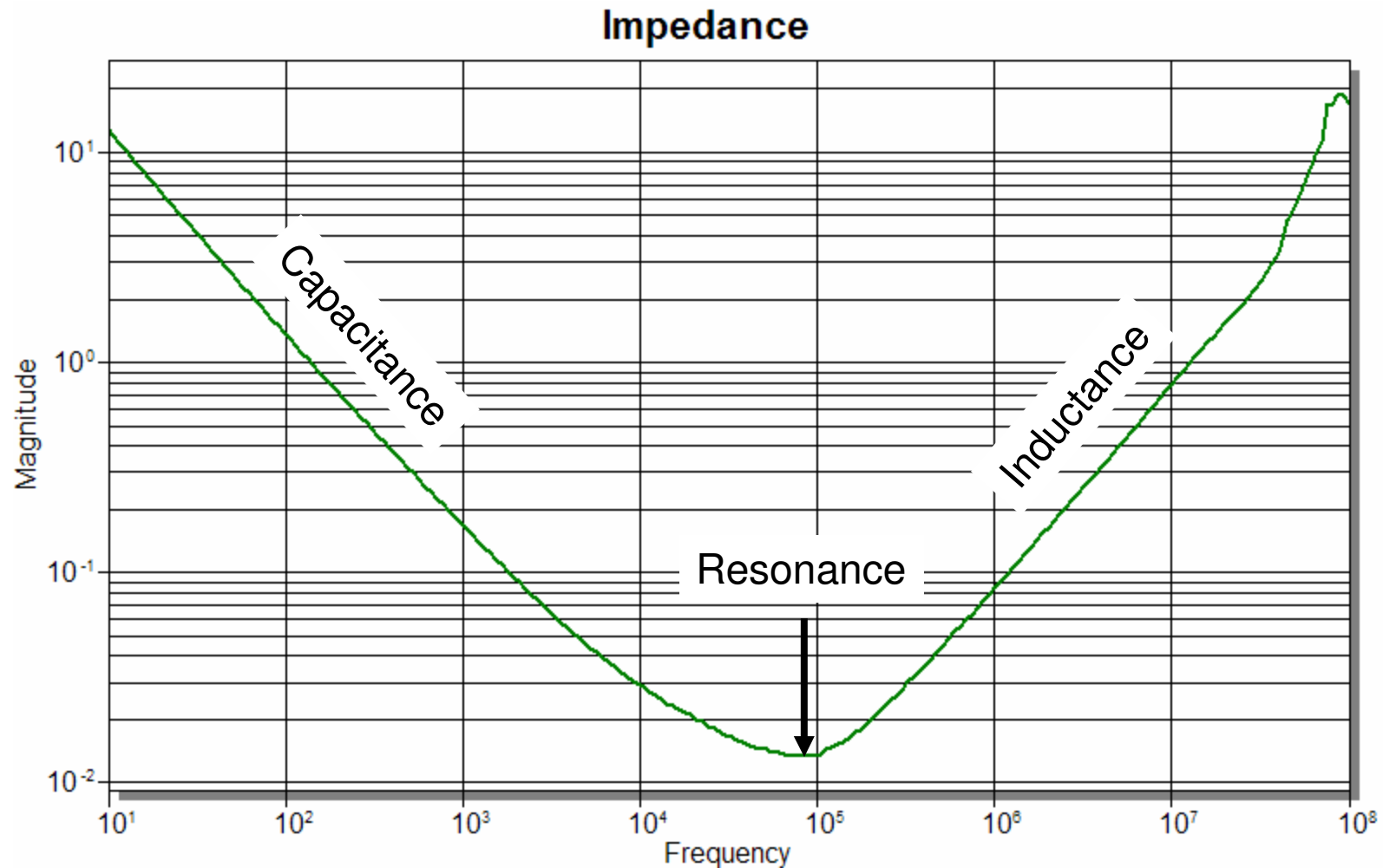
Simple Decoupling Capacitor Mounted to PCB



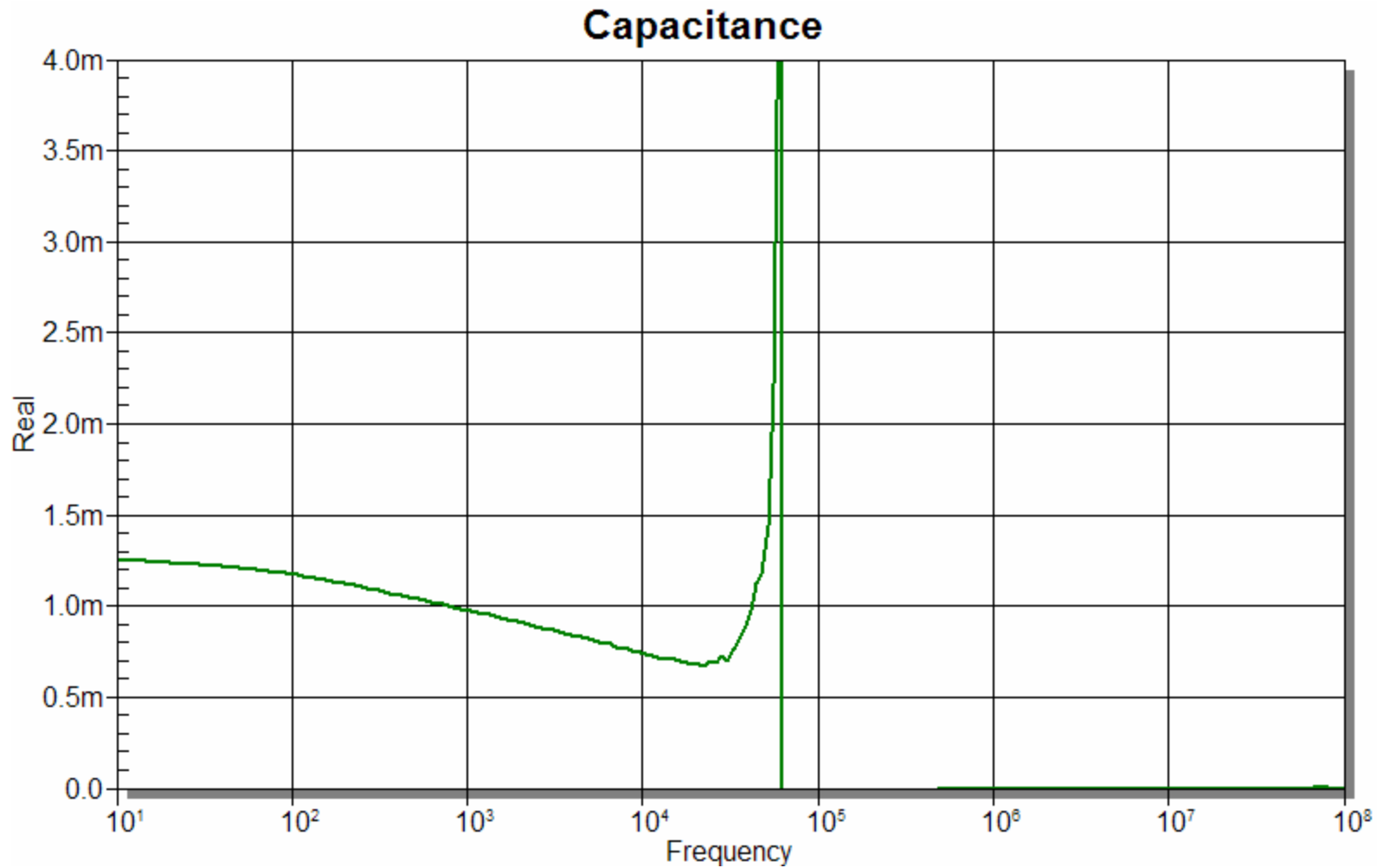
Capacitor Measurement



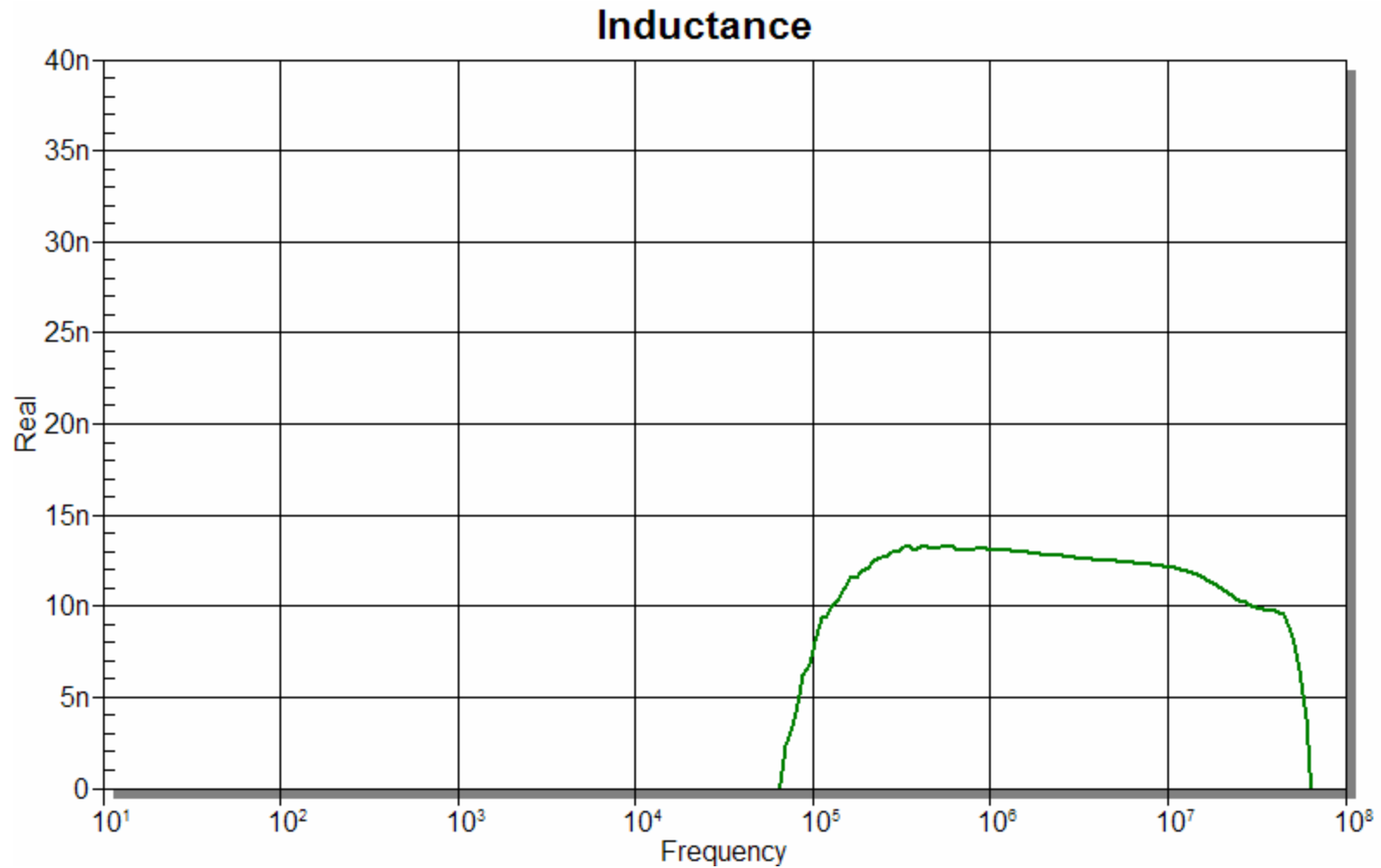
Capacitor Impedance



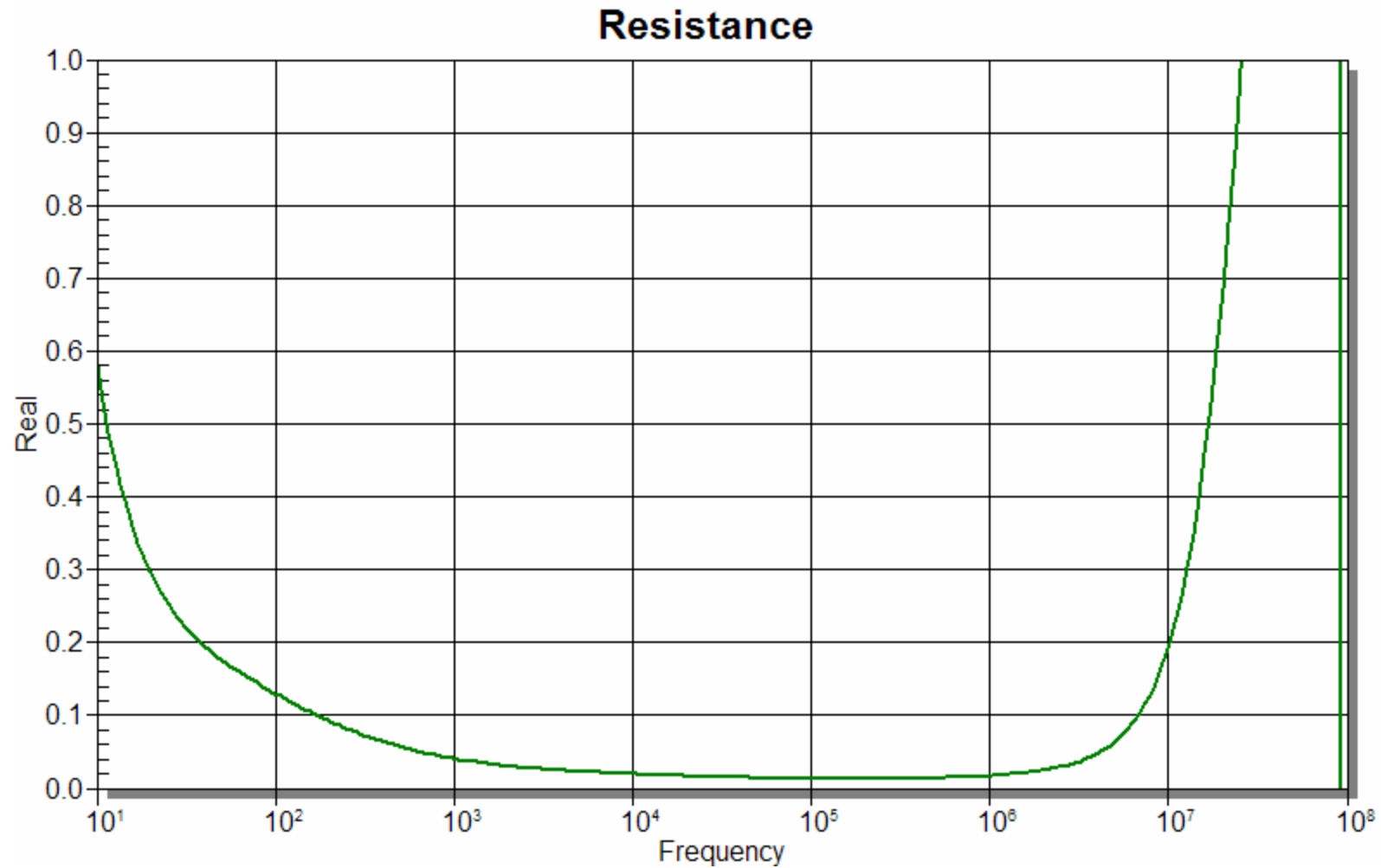
Capacitor Capacitance



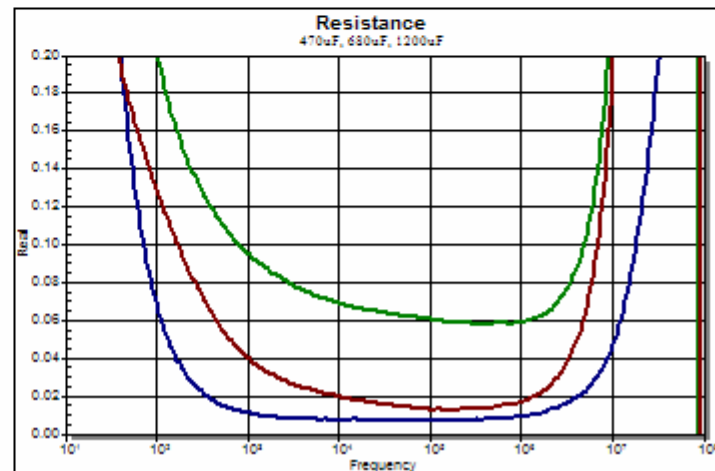
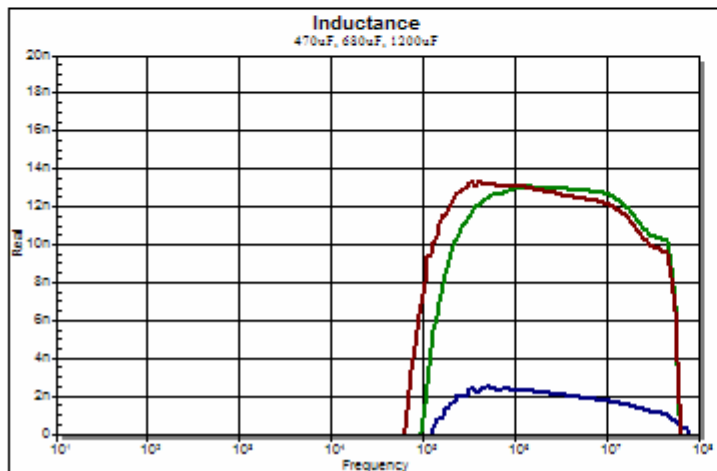
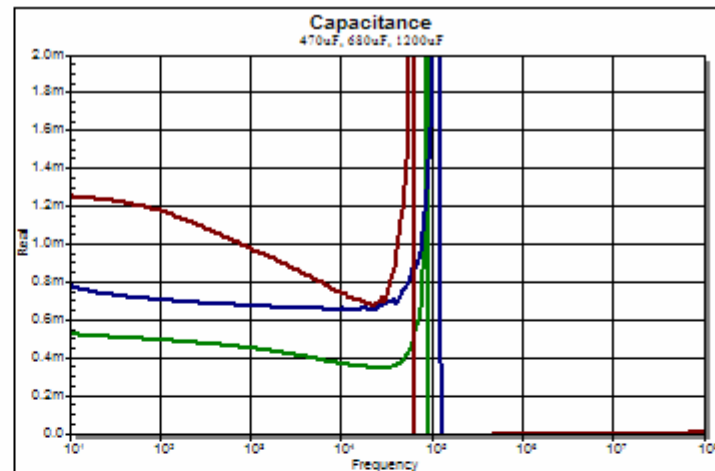
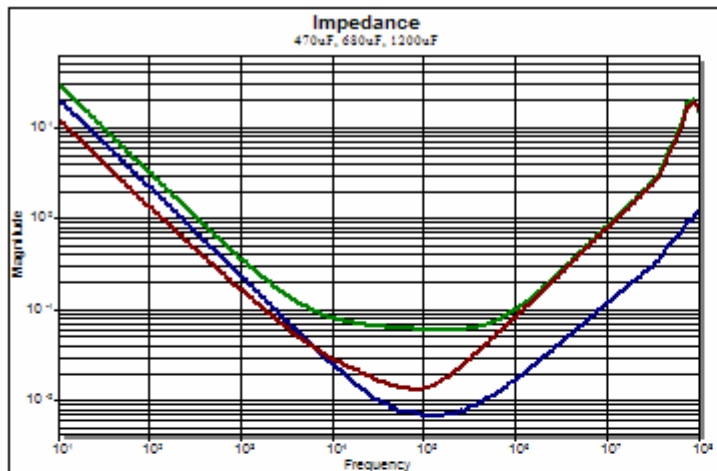
Capacitor Inductance



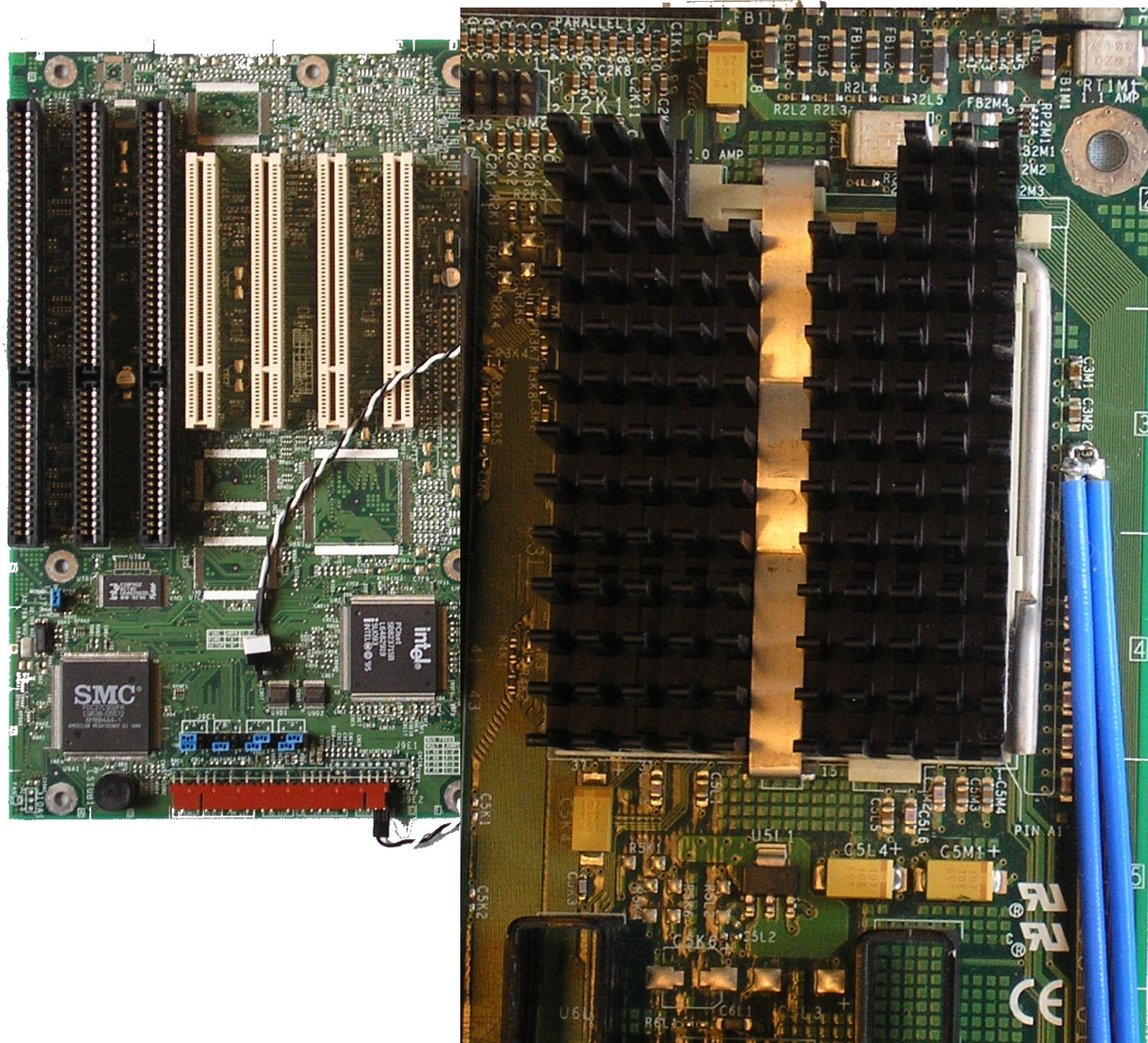
Capacitor Resistance



Impedance of Multiple Shunt Caps

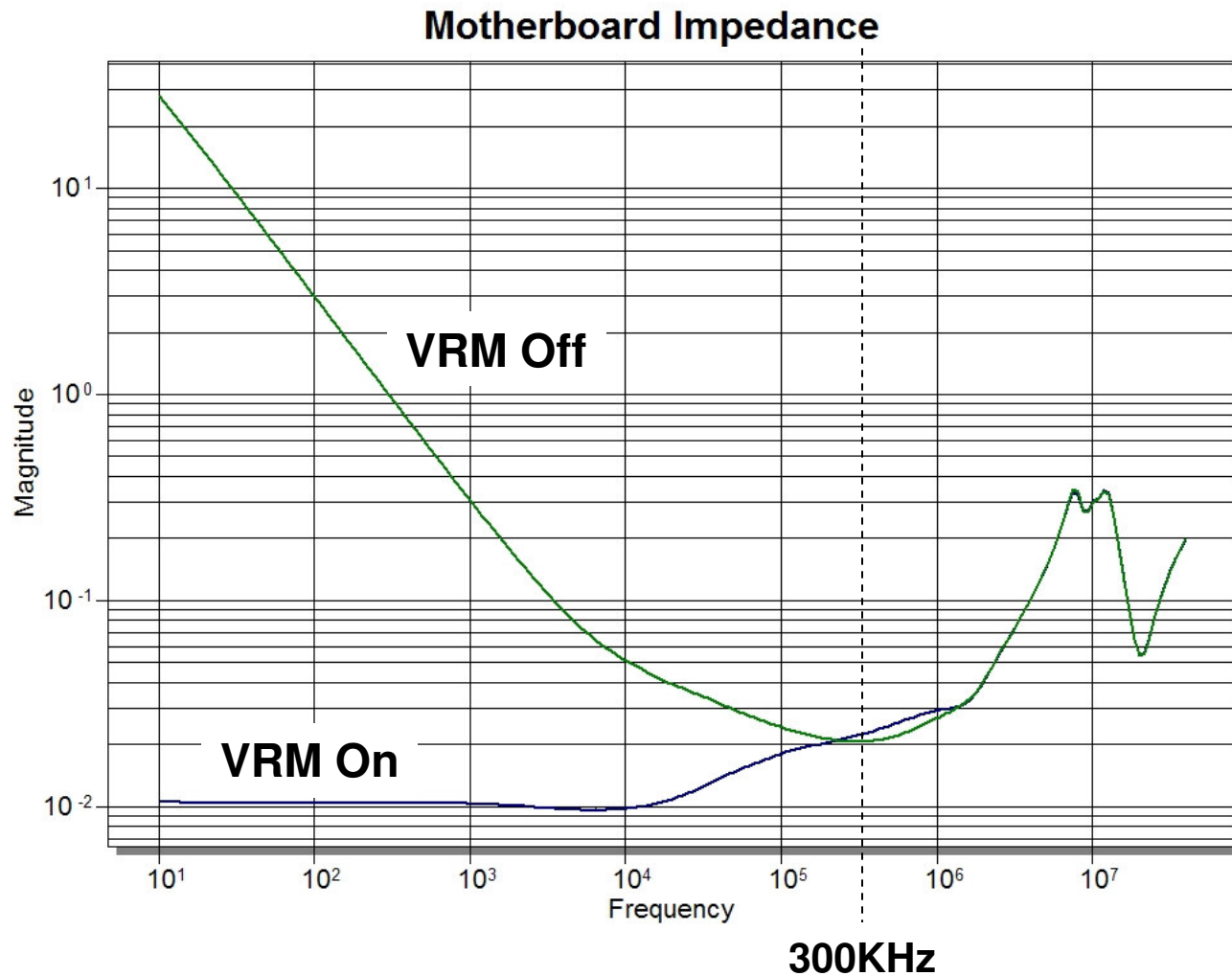


PDN Measurement Example



**CPU Bias on
PC Motherboard**

PDN Impedance



P4800 PDNA Summary

- Wide Bandwidth
 - 10Hz to 18GHz
- High Sensitivity
 - Better than $50\mu\Omega$ to 40MHz
 - Performance above 40MHz depends on VNA characteristics
- Easy Setup
 - No external circuitry
 - No ferrites
- Flexible
 - Self Impedance
 - Transfer Impedance
- Convenient
 - Coaxial or probe measurement
 - No external data manipulation required

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