Agenda

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

- Higher Density
- Higher Current
- Higher Power Dissipation
- Lower Voltage
- Lower Voltage Noise Margin
- Lower PDN Impedances
- Wider Bandwidth
- Faster Switching Speeds
Example DUT’s

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

• Target Shunt Impedance
  – Approximately 1mΩ

• Measurement Frequency:
  – VRM: DC to 100KHz
  – PCB: 1KHz to 40MHz
  – IC Package: 1MHz to 3GHz
Reflection Measurement

Incident Signal

Reflected Signal

$Z = f(\Gamma)$
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 Impedance

Magntitude vs Frequency graph showing resonance and capacitance and inductance regions.
Capacitor Capacitance
Capacitor Inductance
Capacitor Resistance
Impedance of Multiple Shunt Caps
PDN Measurement Example

CPU Bias on PC Motherboard
PDN Impedance

Motherboard Impedance

VRM Off

VRM On

300KHz
P4800 PDNA Summary

- **Wide Bandwidth**
  - 10Hz to 18GHz
- **High Sensitivity**
  - Better than 50μΩ 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
Contact Info

www.ultimetrixinc.com
info@ultimetrixinc.com
+1-978-328-1067