Identifying the root cause of EMC Compliance Problems at a PCB level

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Director of Product Management

Agenda

- Radiated Emissions Testing
- Very-Near-Field Implementation
- High Resolution Scanner
- Sample Results
- Far Field Prediction
- Conclusion

EMSCAN Introduction

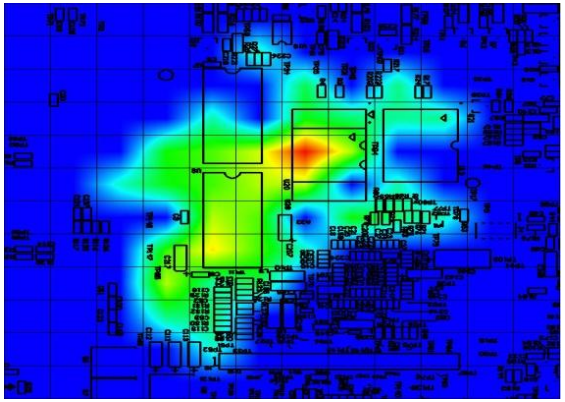
World Leading Developer of **Fast** Magnetic Very-Near-Field Measurement Applications

Real-Time Visual Test Solutions for Antenna and PCB **Designers** and Verification **Engineers**

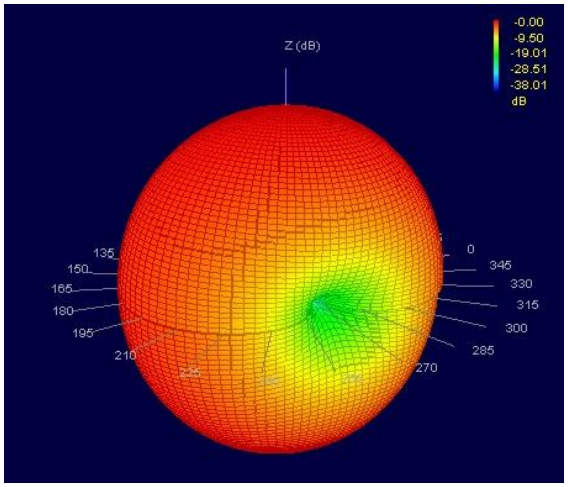
Pre-Compliance Not Compliance

EMSCAN Products

- EMxpert
  - EMC/EMI diagnostic tool enabling designers to rapidly diagnose and solve EM problems in a single design cycle in their own lab environment



- RFxpert
  - APM tool enabling engineers to quickly evaluate and optimize their designs with real-time antenna performance characterization at their desk



Radiated Emissions Testing

OVERVIEW

Existing Solutions

- Chambers
  - Slow testing
    - Compliance
  - High CAPEX (in-house)
    - Real-estate
    - Qualified technicians
  - High OPEX (third party)
- Probes
  - Slow testing
  - Resolution nm
- Simulation software
  - Time consuming to customize per PCB
  - Extensive training required

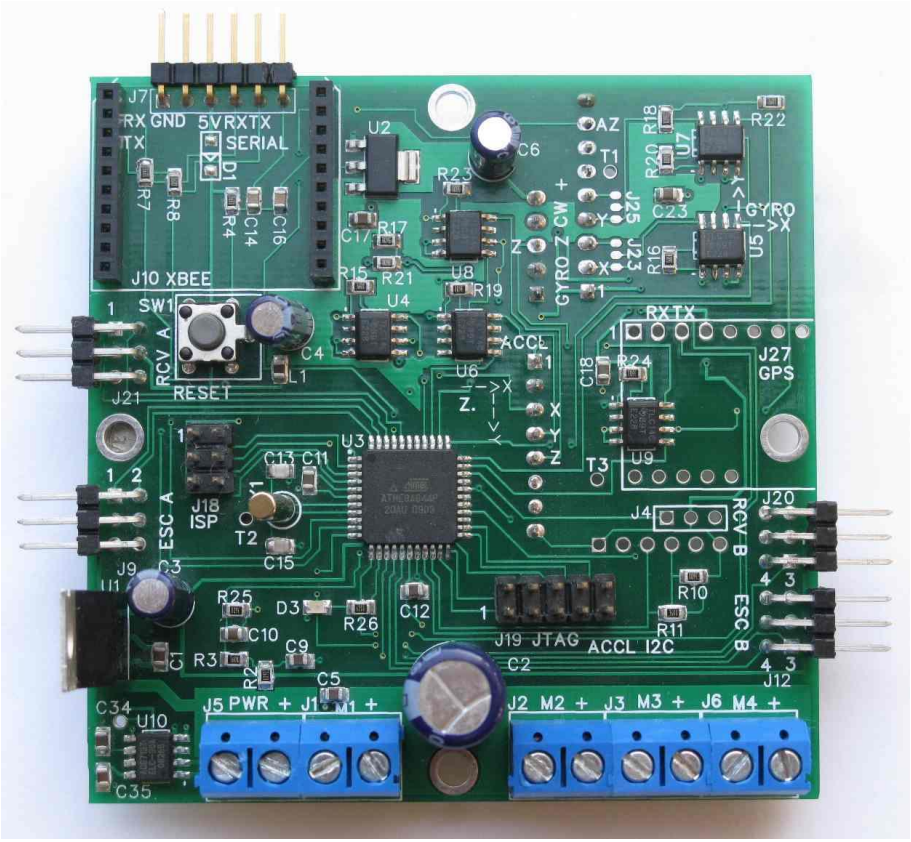
Every EMI (electromagnetic interference) problem ultimately starts or ends at an electronic circuit

Daryl Gerke and Bill Kimmel

IN COMPLIANCE MAGAZINE JULY 2013

PCB Radiated EMC Issues

- EMC prevention an afterthought
- Little interest in EMC
- EMC as a black art

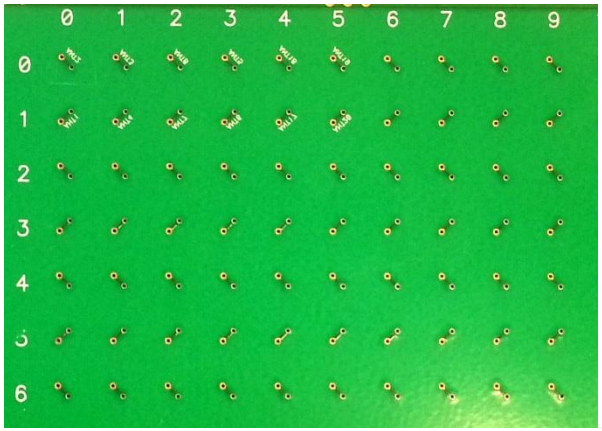


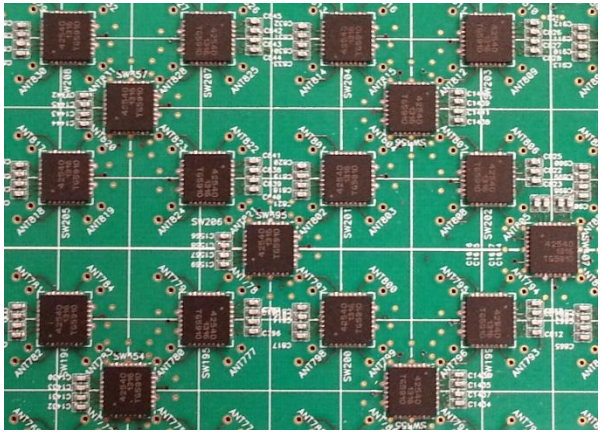
Very-Near-Field Implementation

A BETTER SOLUTION

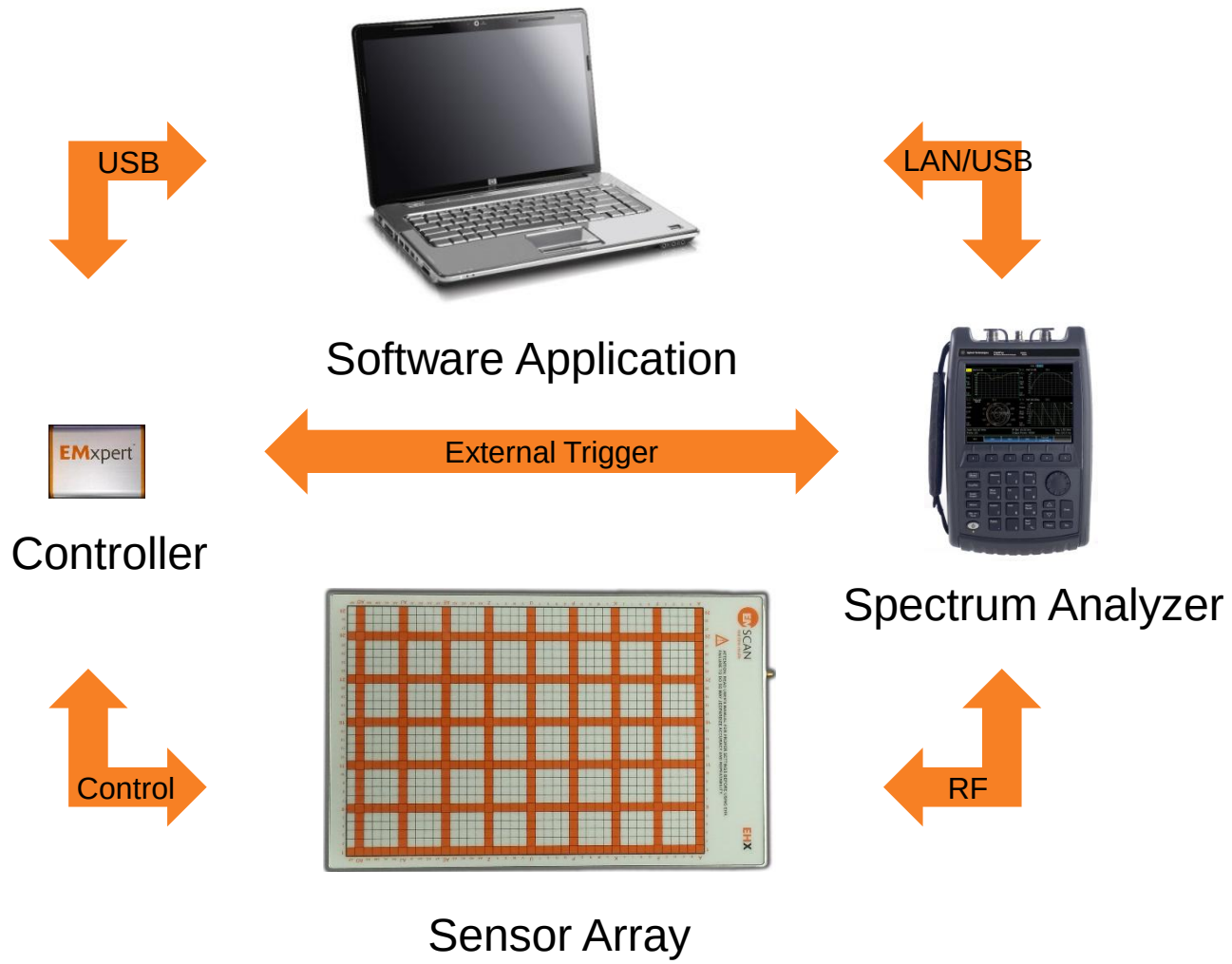
Scanning Array of Probes

- 1218 probes in a 29 x 42 array
- Magnetic field loop probes
  - Sensitive down to -135 dBm
  - Inefficient for EMI isolation
  - Broadband
- 7.5 mm to 0.12 mm resolution
- Scan area 21.8cm x 31.6cm
- Real-time measurements (<1 sec)



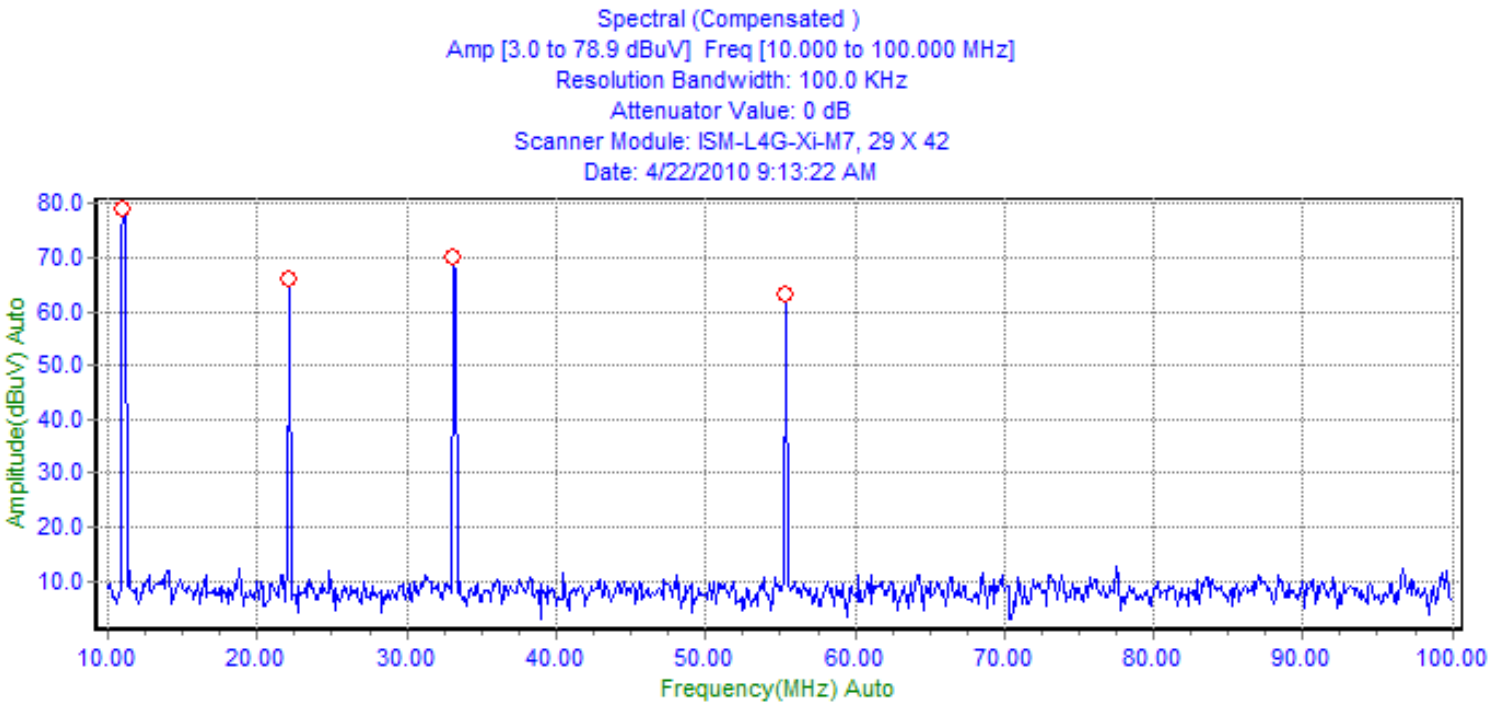


System Configuration



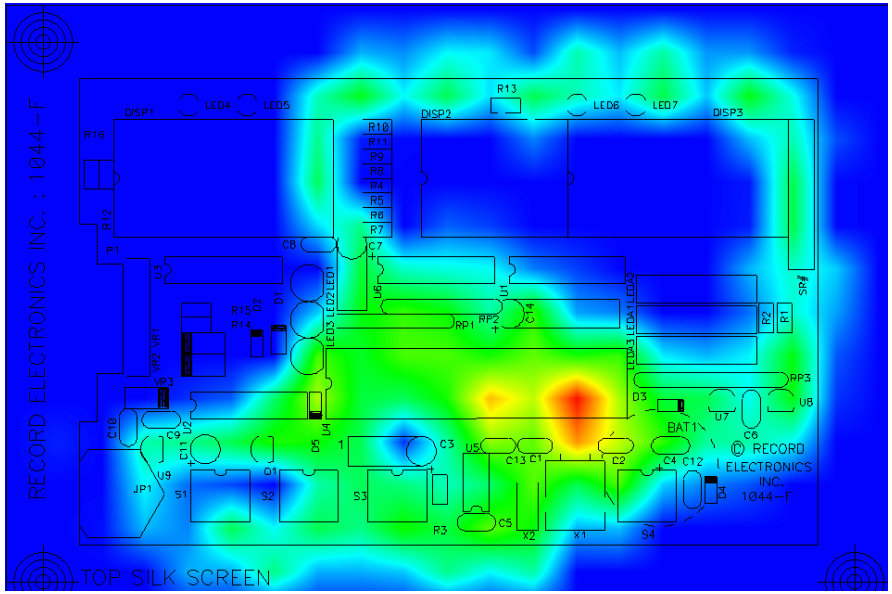
Spectral Scan

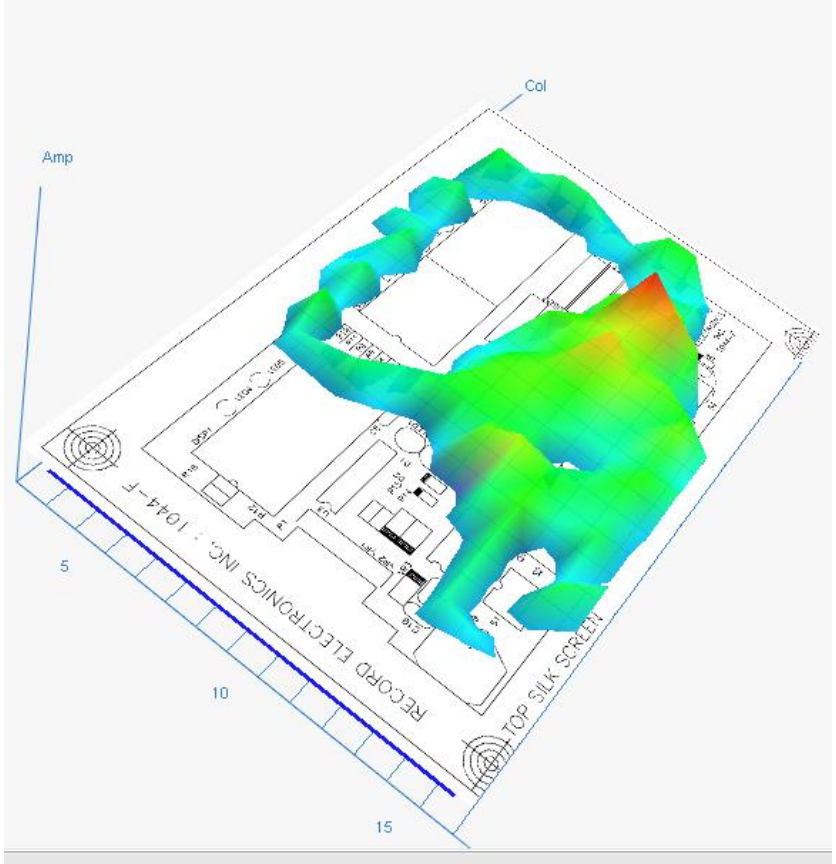
- Identify the frequencies of emission



Spatial Scan

- Visualize where the emissions are coming from



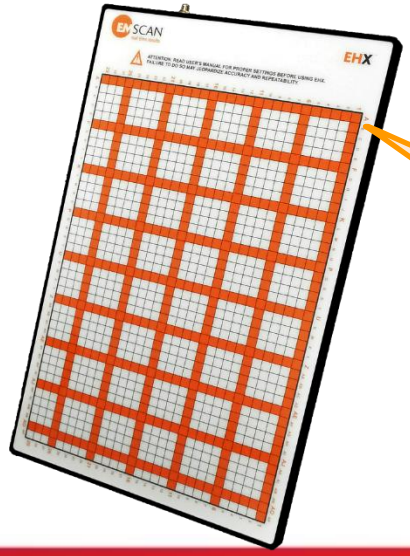


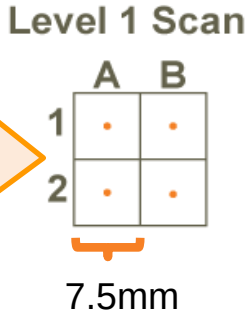
High Resolution Scanner

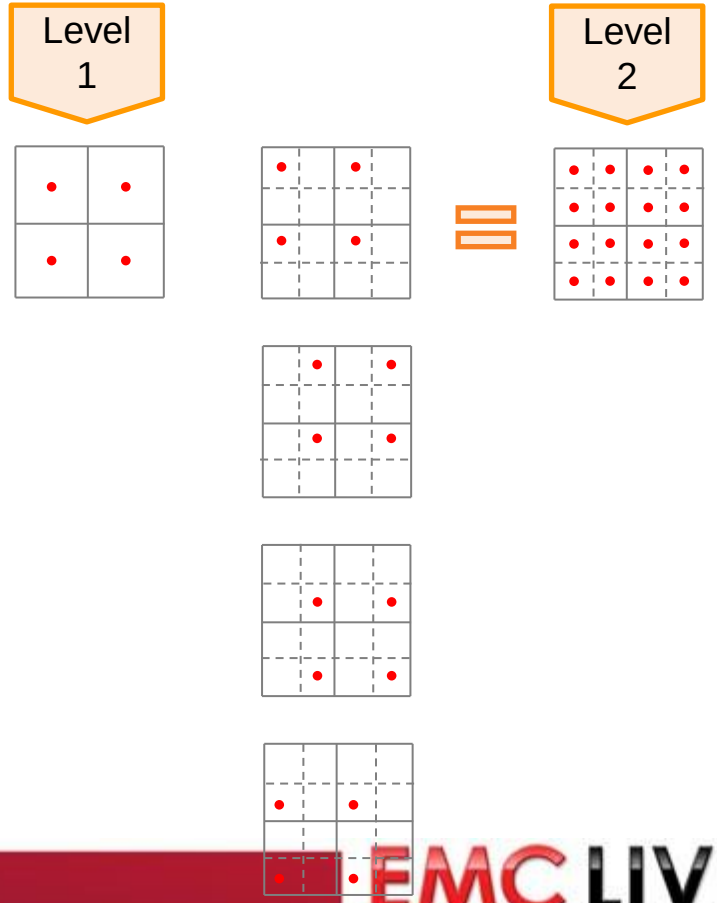
BEST OF BOTH WORLDS

Higher Resolution Spatial Scan

- Probe spacing is 7.5mm
- Move the entire probe array to synthesize small probe spacing
- Up to Level 7 (0.1mm)

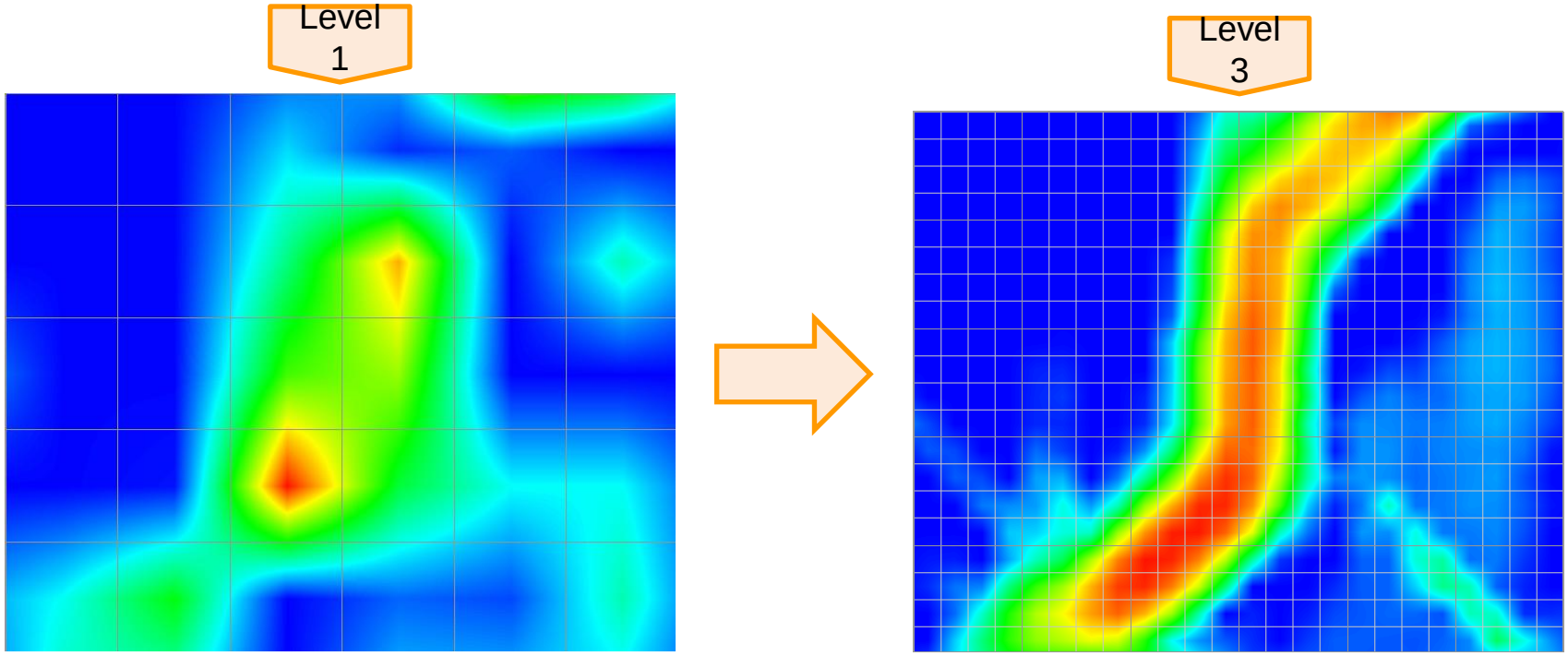






Higher Resolution Spatial Scan

- Detail of small feature available
- Even inside components like ICs

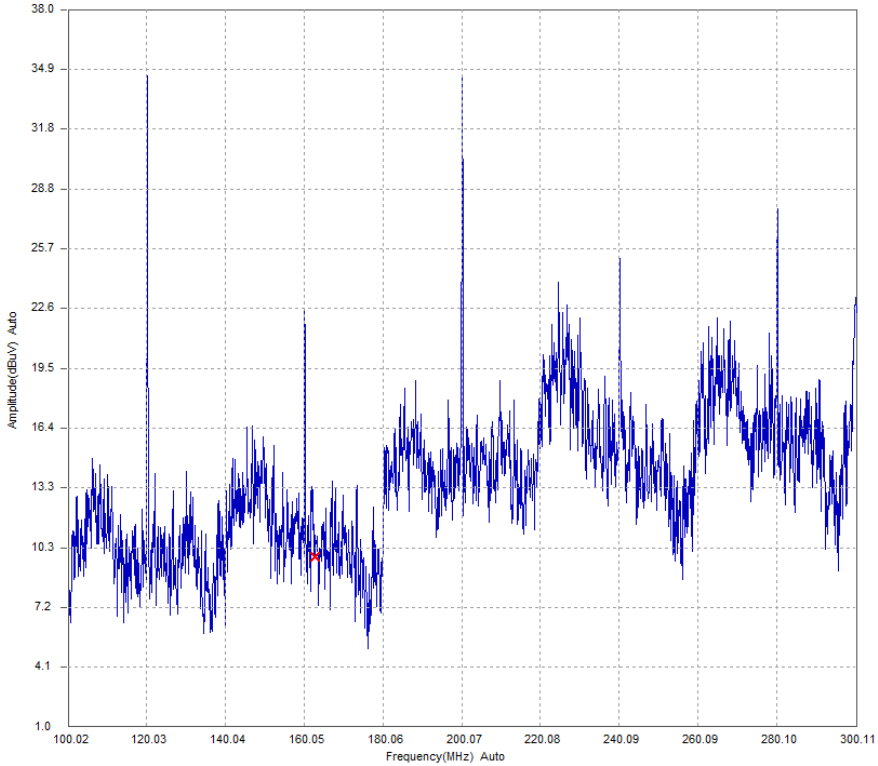


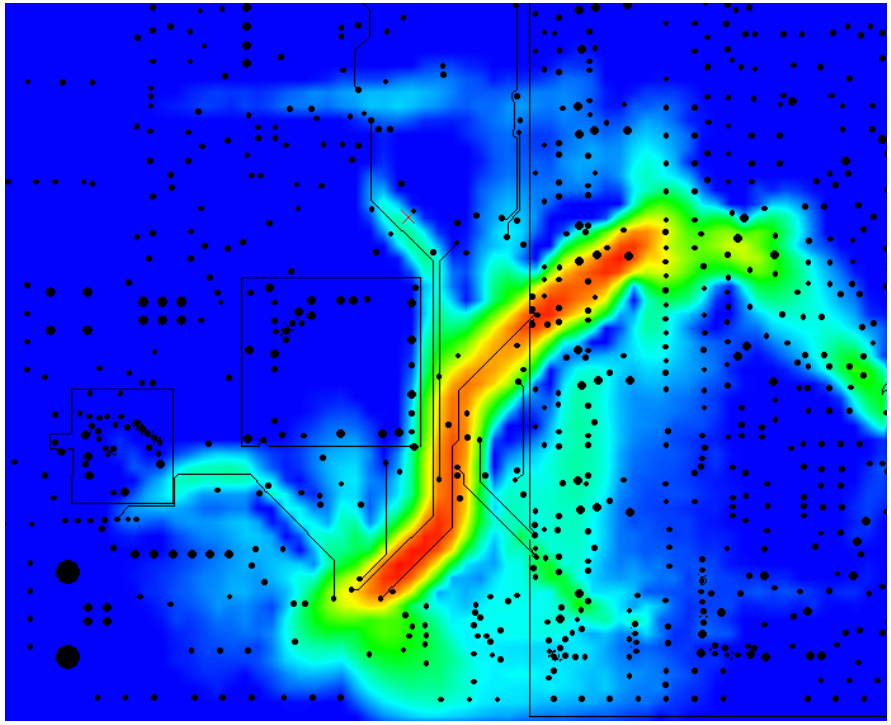
Sample Results

FOLLOWING EMISSIONS ACROSS A PCB

Analyzing a PCB

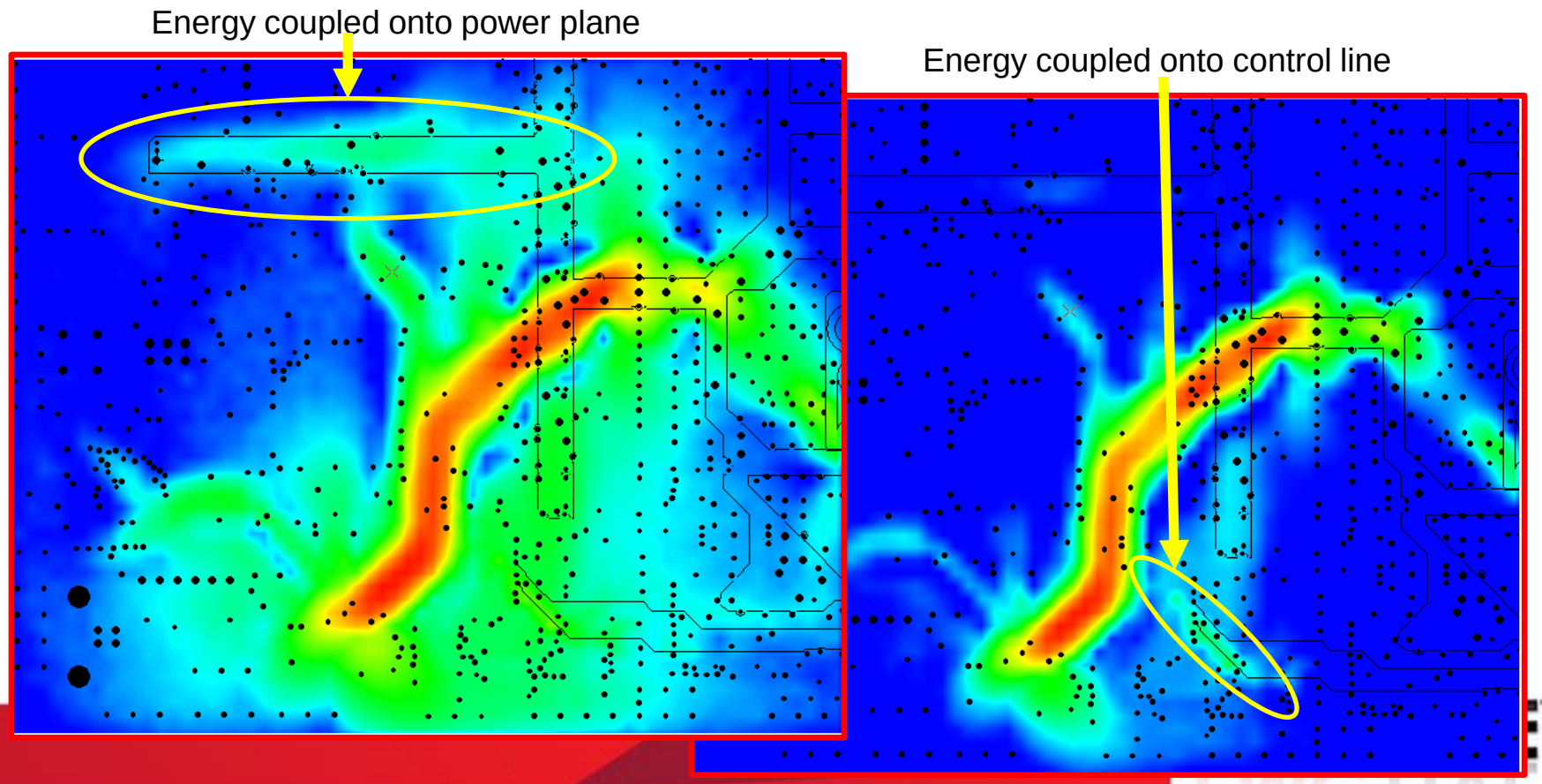
- First view of a scan give spectral content and aggregate spatial content





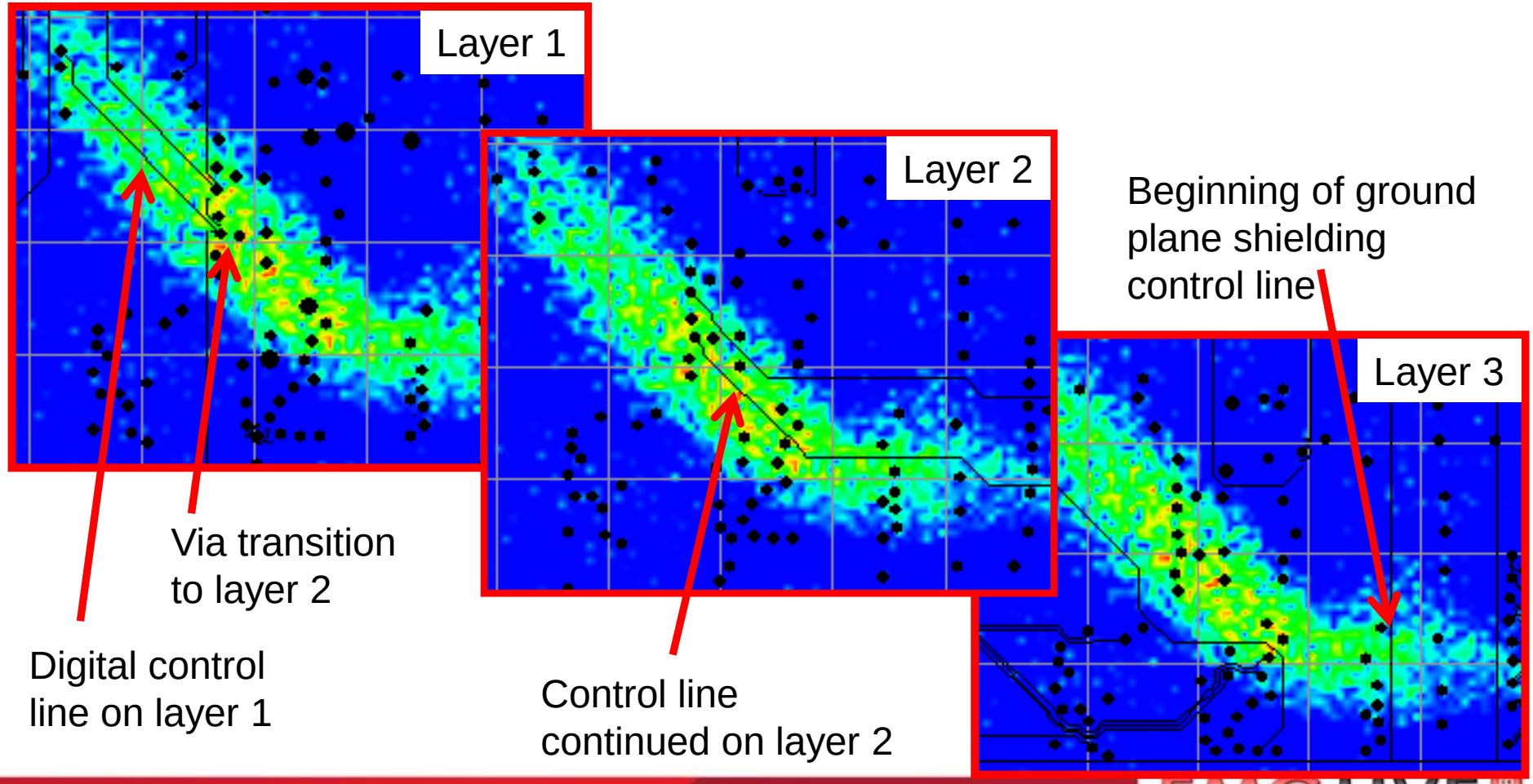
Analyzing a PCB

- Jump around by frequency or location to follow signals
- Load new PCB layers to correlate to features



Analyzing a PCB

- Able to follow the signal on the traces as it goes between layers.



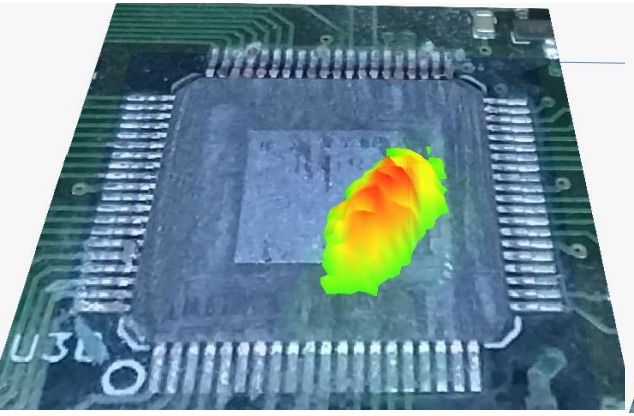
Sample Results

PEERING INSIDE AN IC

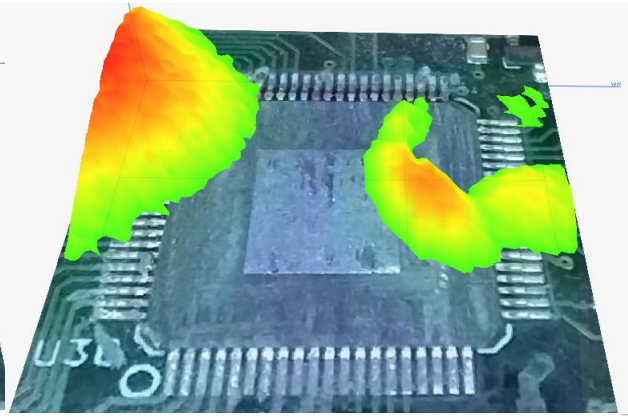
Emissions From Inside the IC

- Small PIC with die exposed
- About 2 minutes per scan

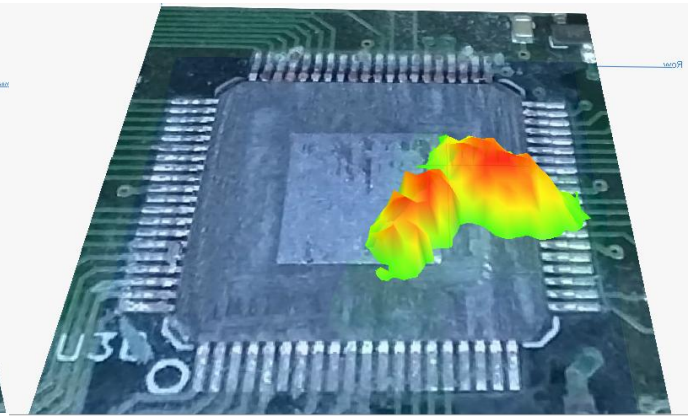
100 MHz



120MHz

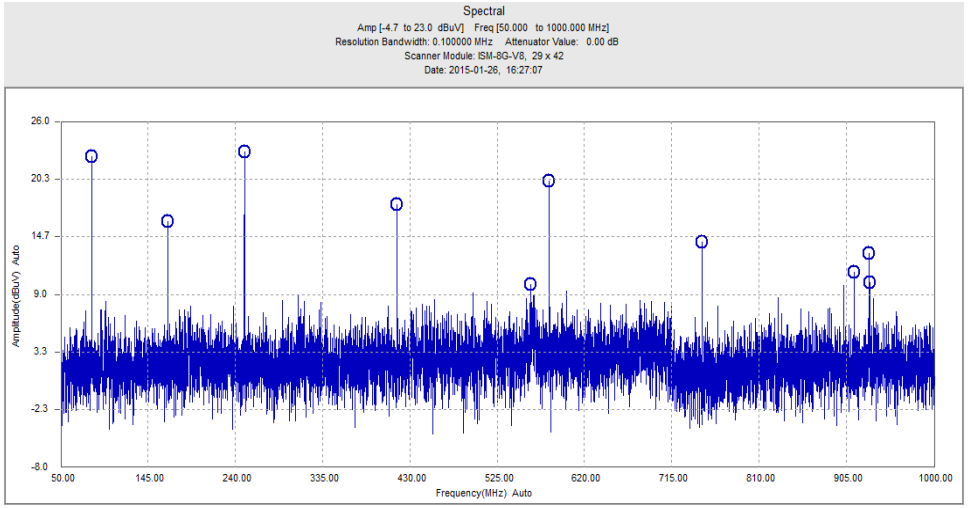


130MHz



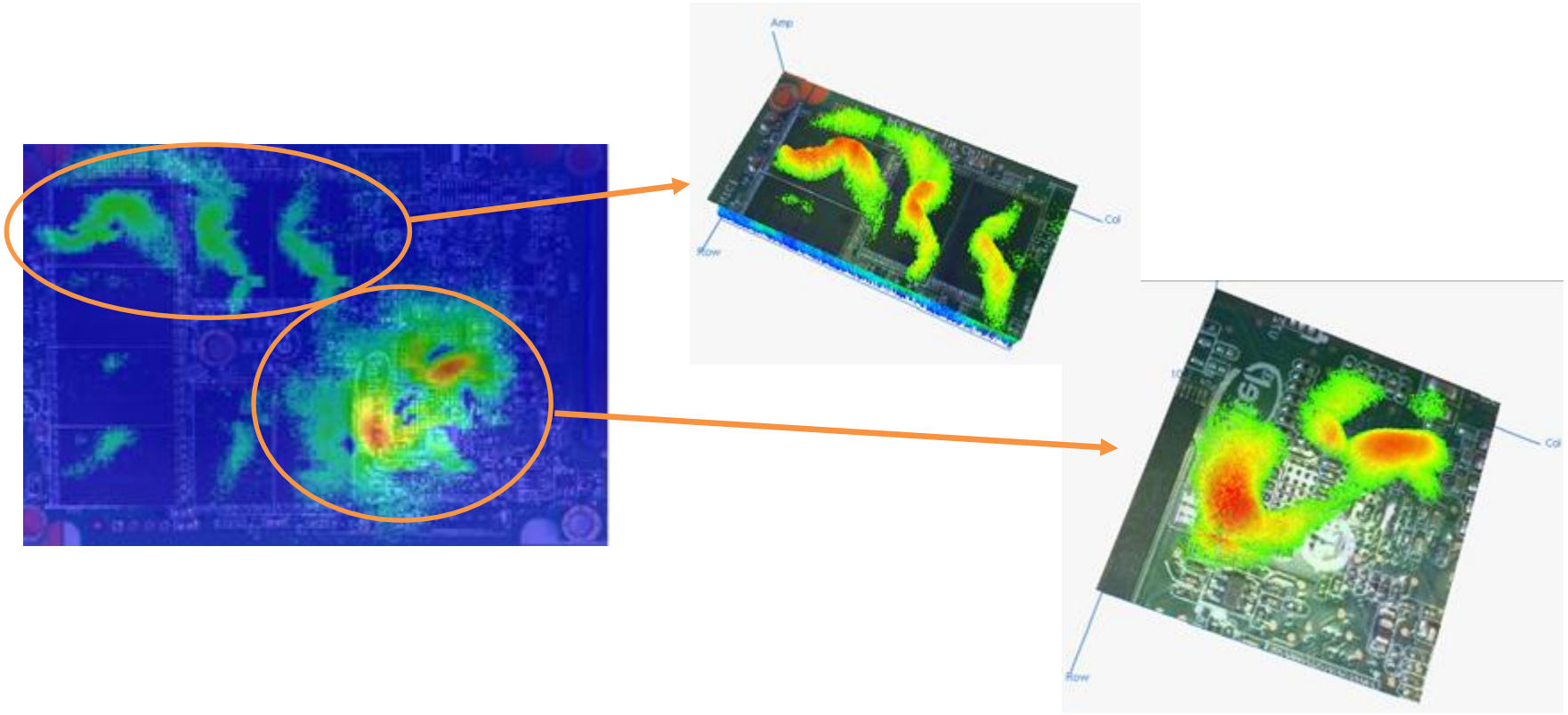
Emissions From Inside the IC

- Intel SSD
- Start with spectral emissions



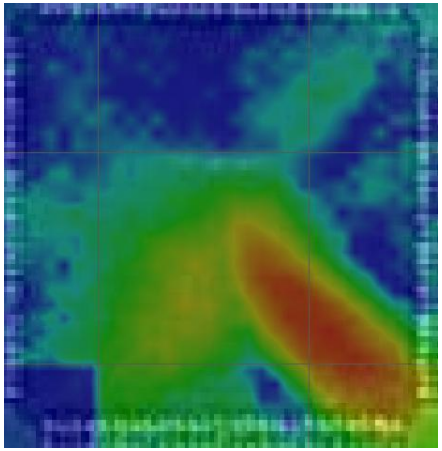
Emissions From Inside the IC

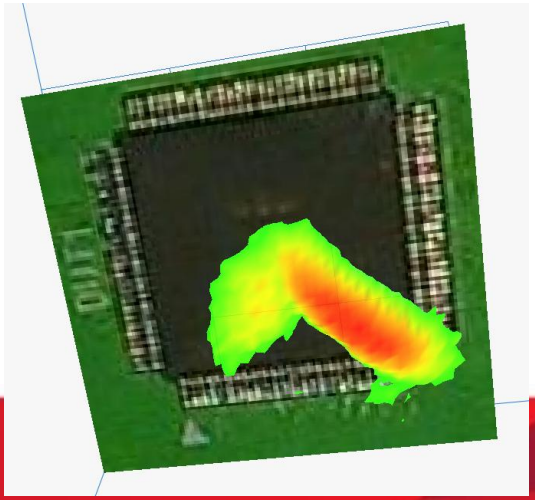
- Then analyze spatial distribution



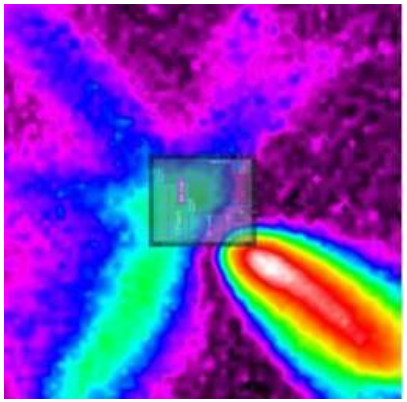
Comparable to Other Techniques

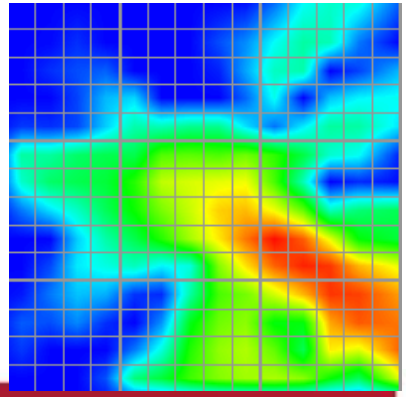
Probe Array Method





Single Probe Method



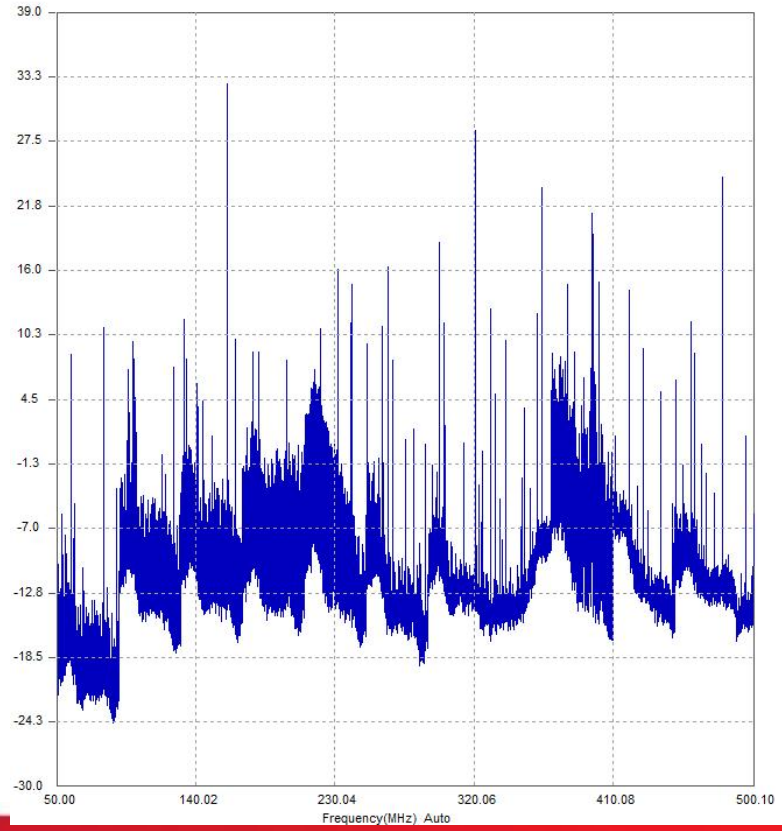


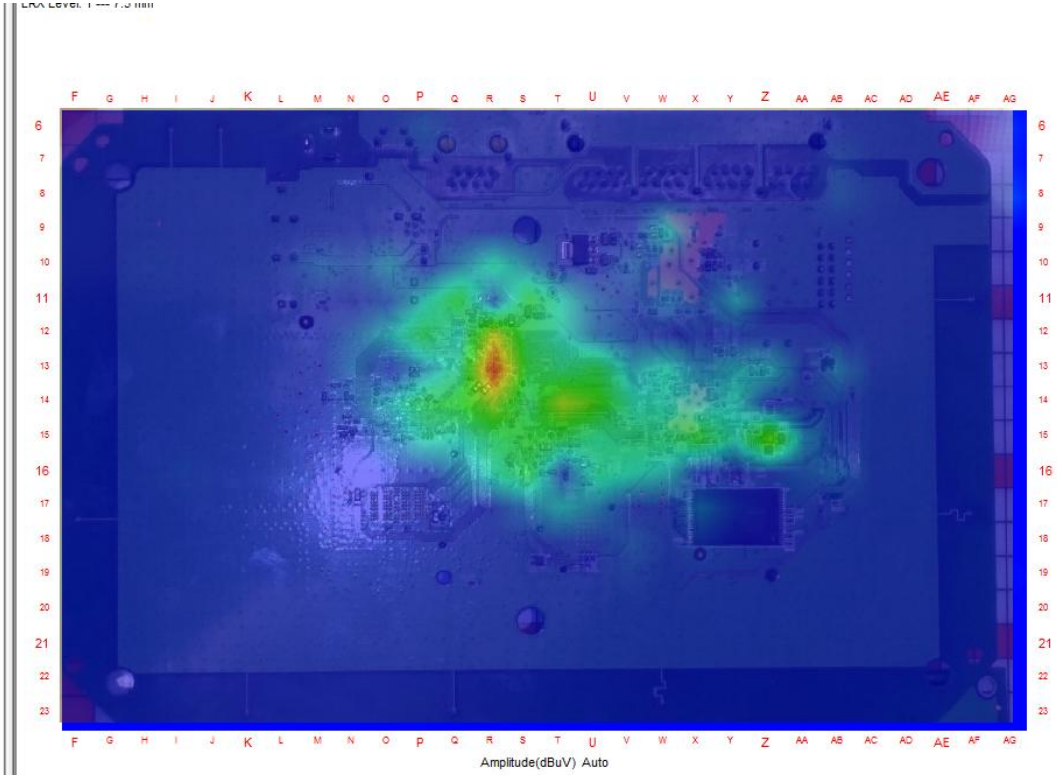
Combining both worlds

BOARD LEVEL AND IC LEVEL

Board Level Testing

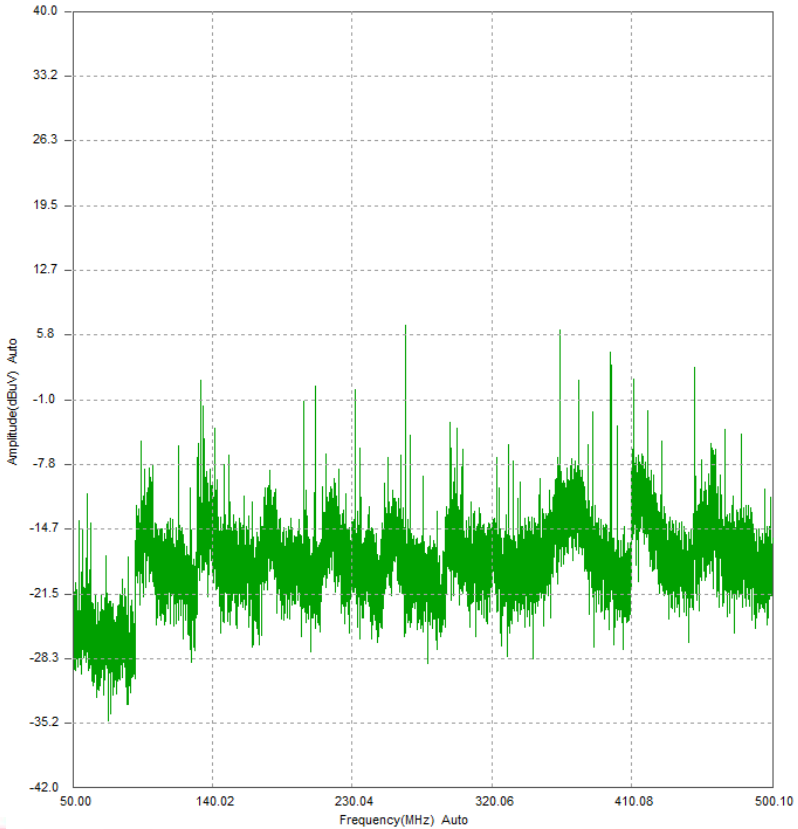
- Quick scan identifies many emissions
- Isolate by location or by frequency

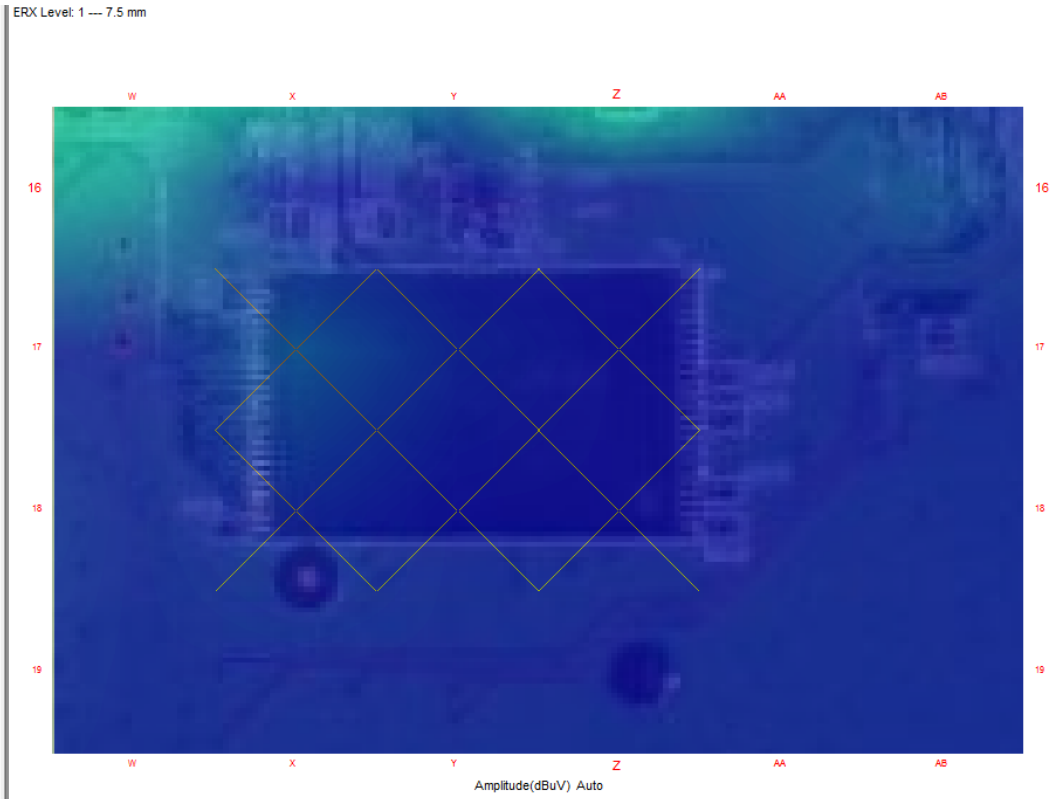




Board Level Testing

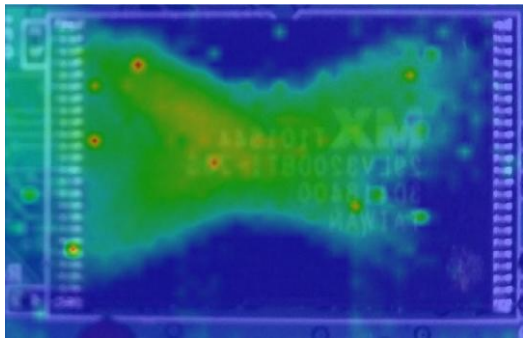
- Highlight on IC and identify relevant frequencies



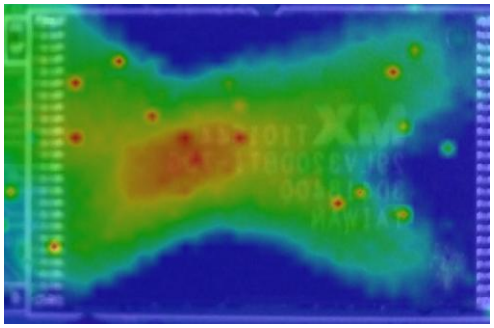


IC Level Testing

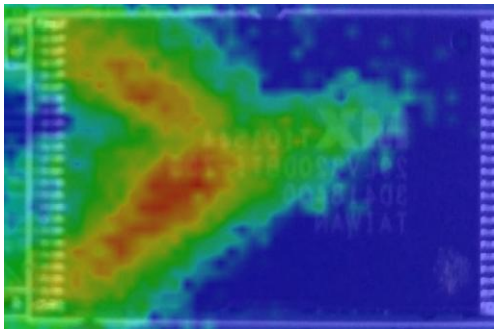
- Go to high resolution
- Identify which frequencies are related



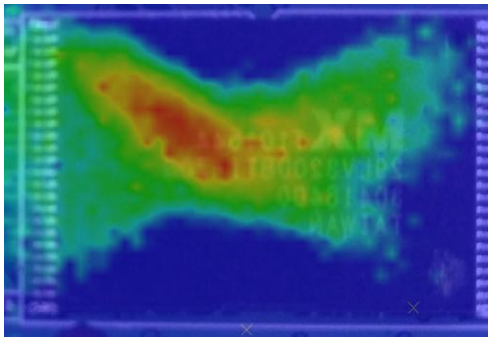
50-500MHz



264MHz



231MHz



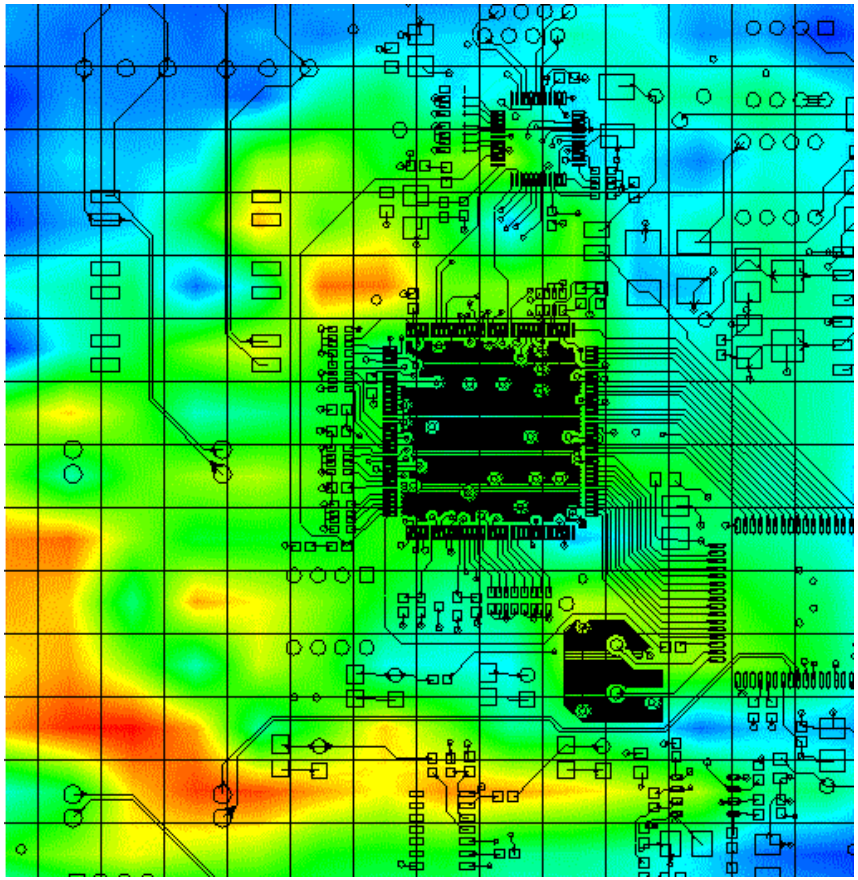
363 MHz

Other Applications

TYPICAL EMC CONCERNS

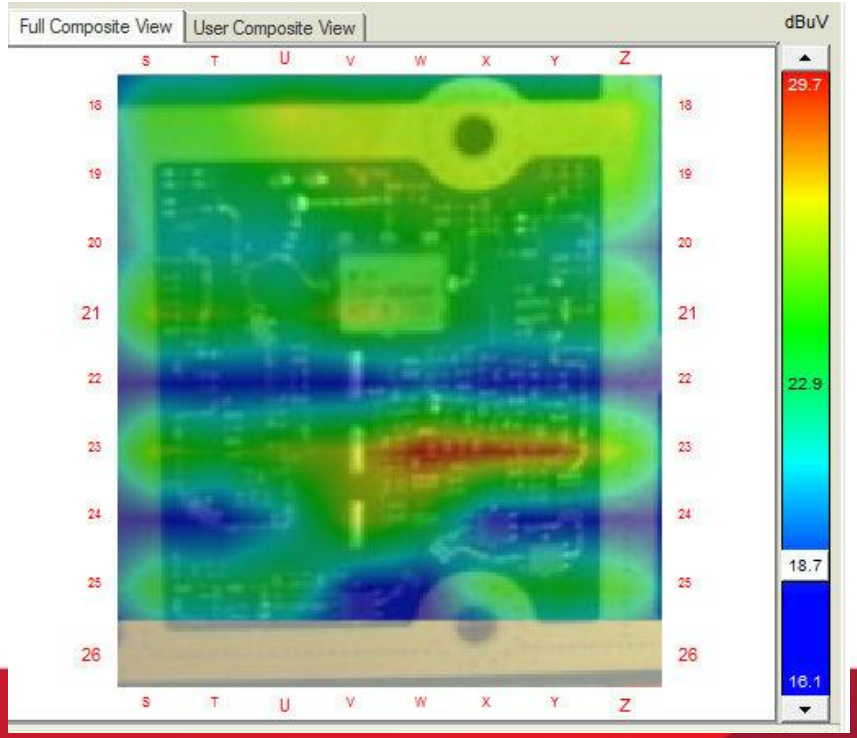
Real-Time

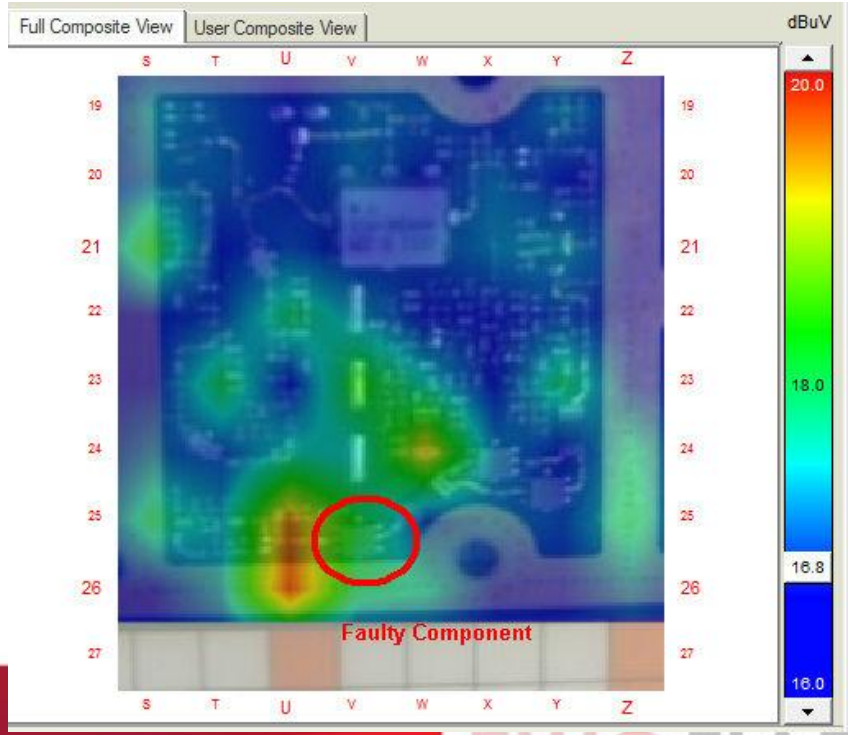
- Changes in real-time
- Intermittent events
- Functional testing
- Different operating modes
- Firmware modifications



A/B Comparison

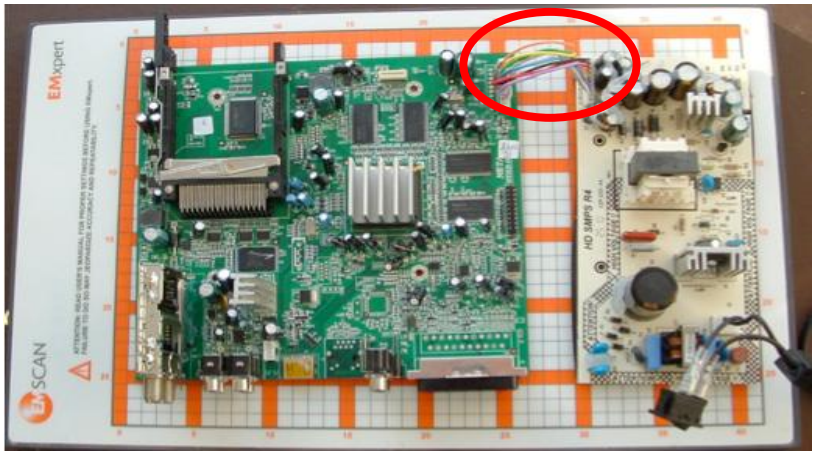
- Obsolescence management
- Production unit versus gold standard
- Fault diagnosis

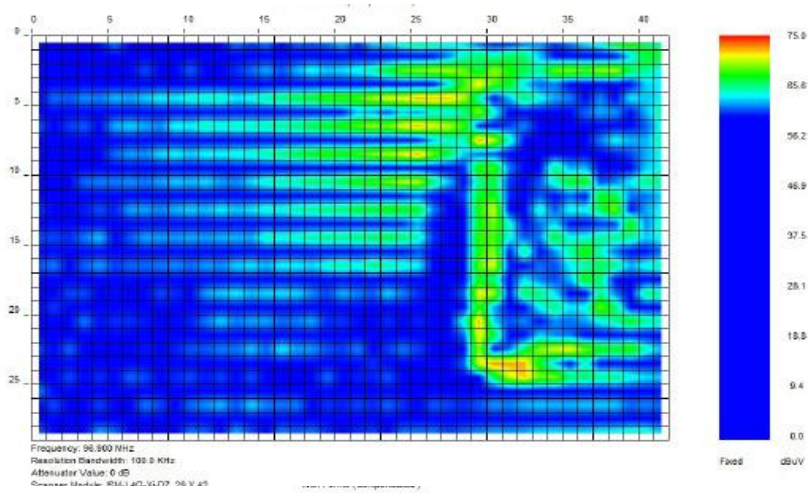


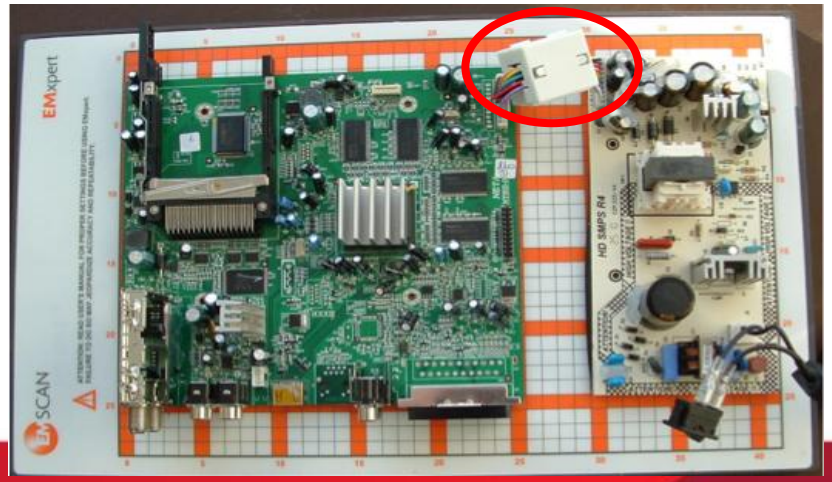


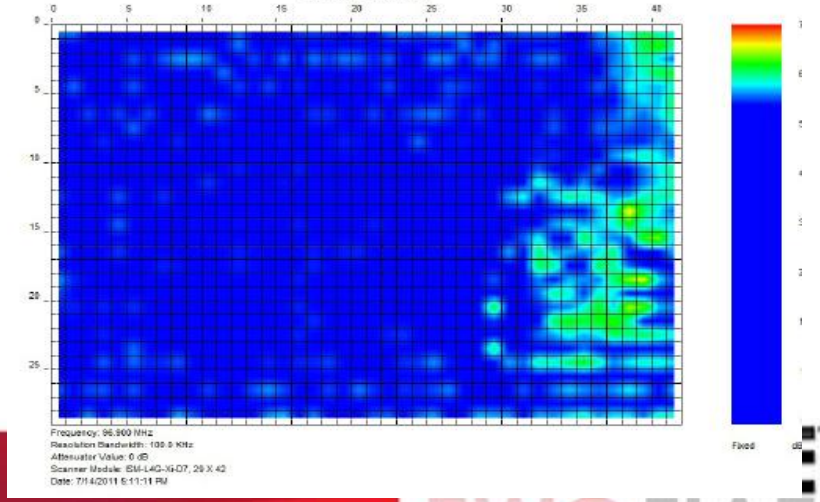
Effectiveness of Filters

- Immediate feedback means trial and error can be used



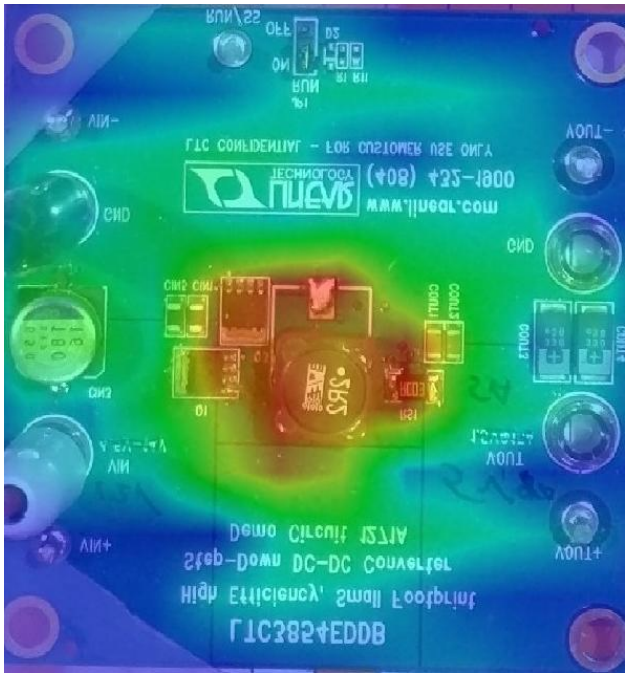




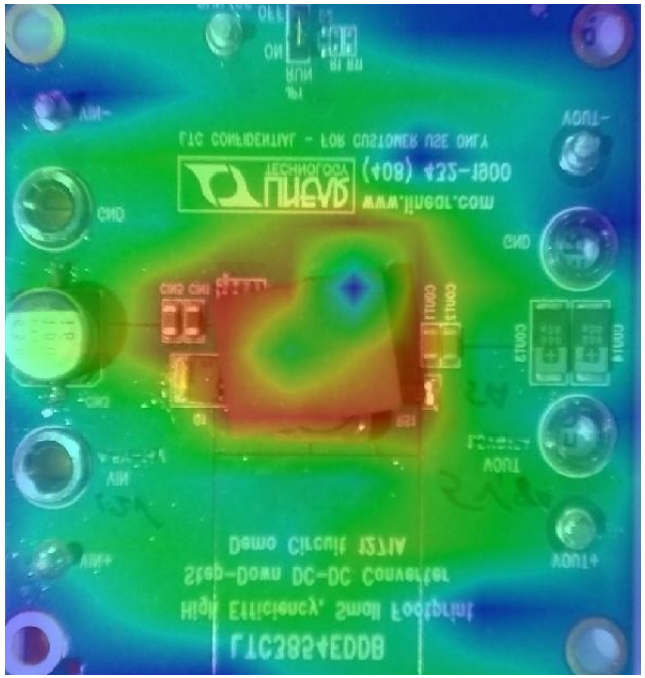


Testing Shielding or Absorbers

- Look for leakage points or new radiation mechanisms
- Test uniformity and effectiveness



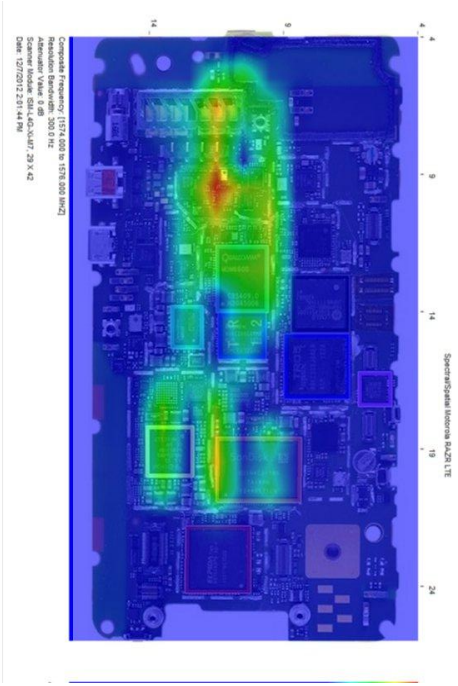
Strong Emissions from Inductor and ICs

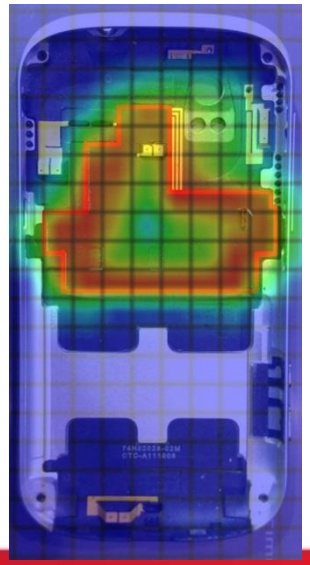


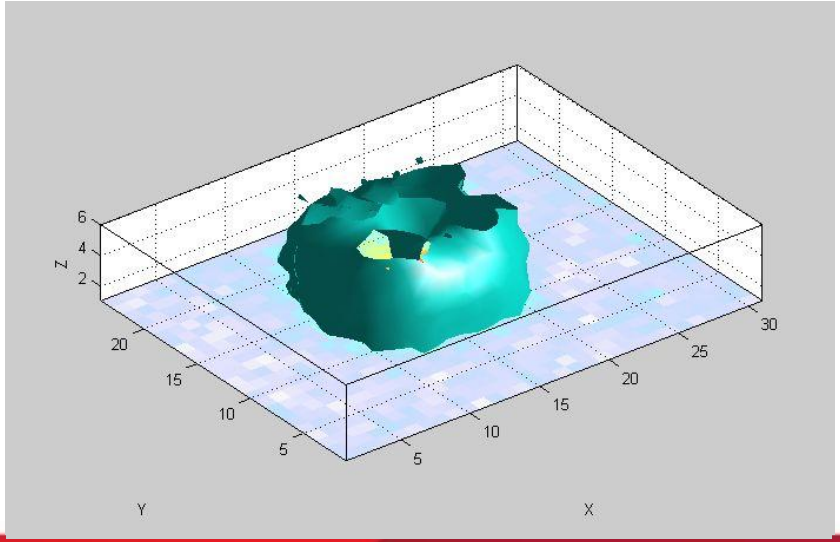
Emissions reduced with small ferrite tile

Non-EMC Applications

- Coexistence
  - PIM 1st to 3rd harmonic 120 dBc
  - Self-interference (de-sense)
- NFC





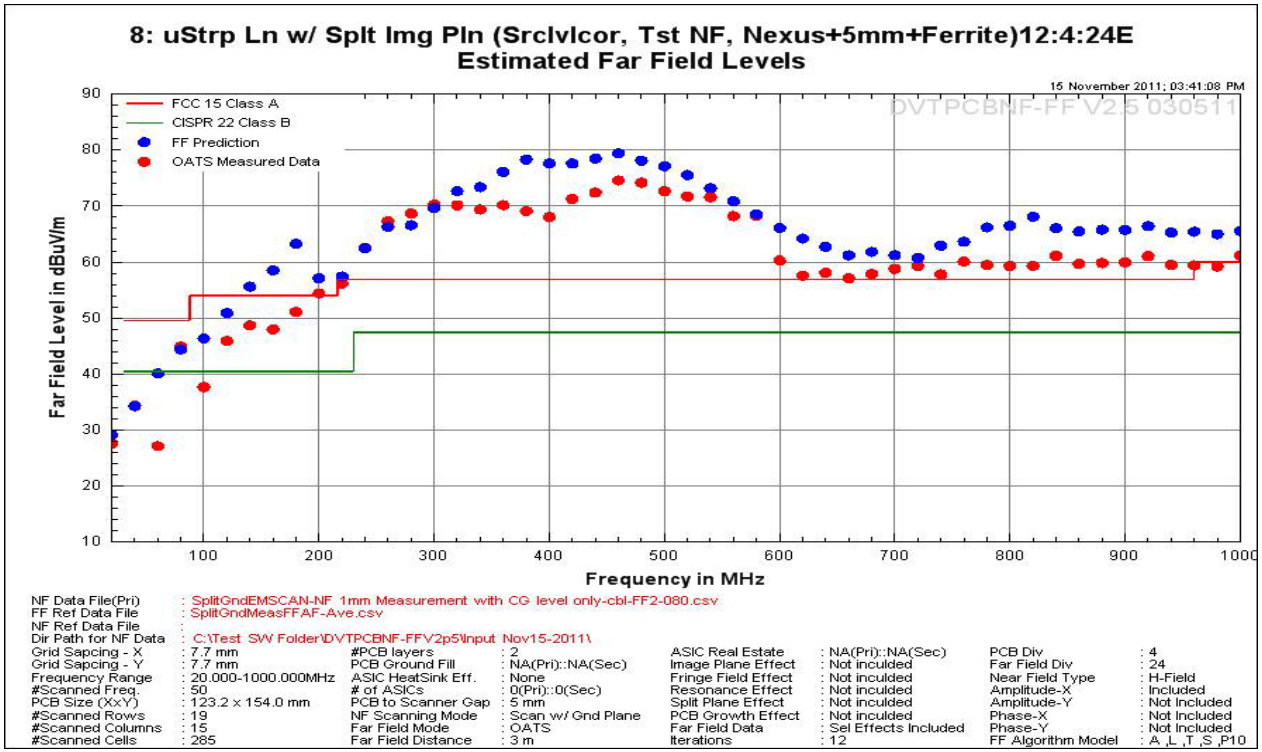


Impact for EMC Compliance

CHAMBER PREDICTIONS

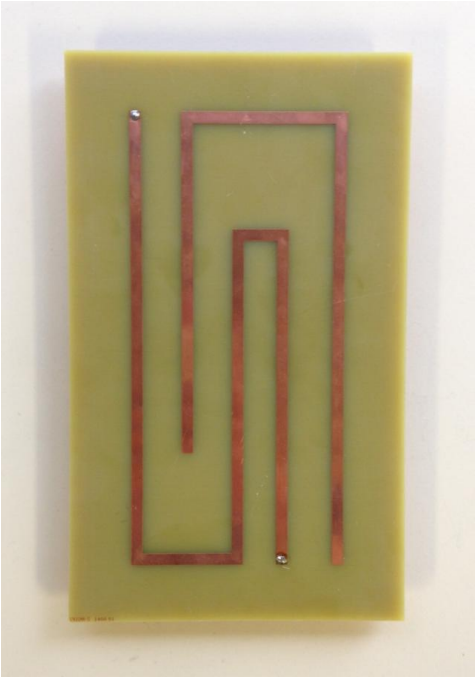
Far-Field Prediction

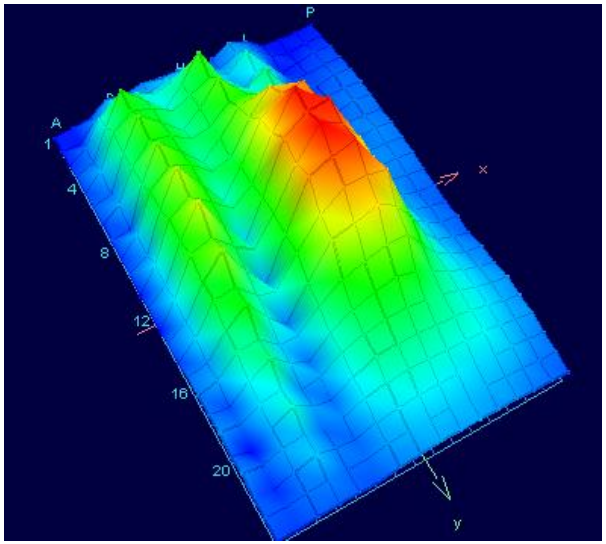
- VNF results to predict Open Area Test Site (OATS) or free space radiated EMI of PCB

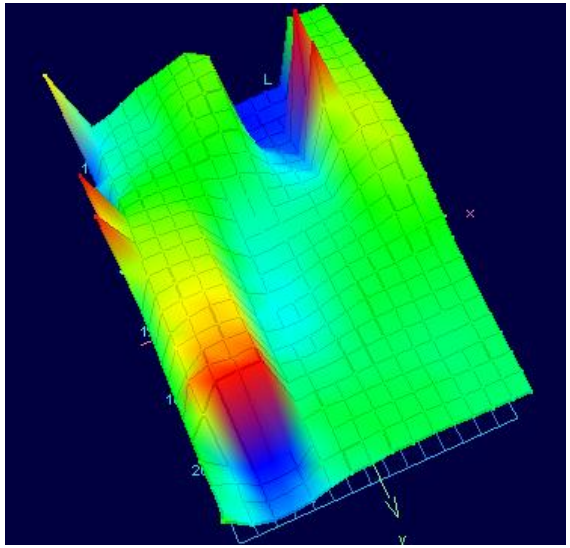


Measure Very-Near-Field

- Measure the very-near-field emission from real source
- Use this as a source model in a simulation package
- Amplitude and phase needed

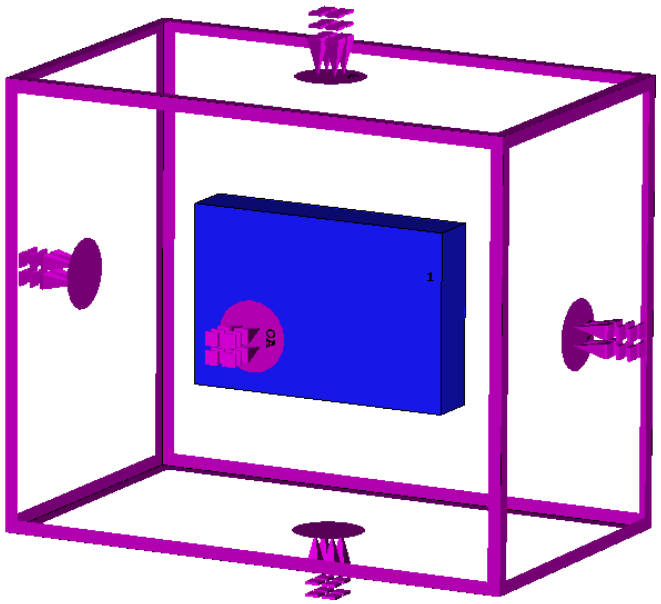




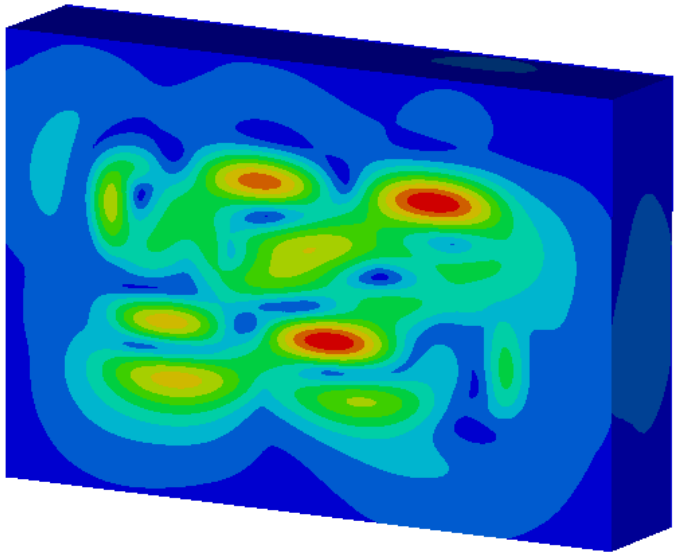


Import into Simulation

- A complex simulated source is replaced with simple surface



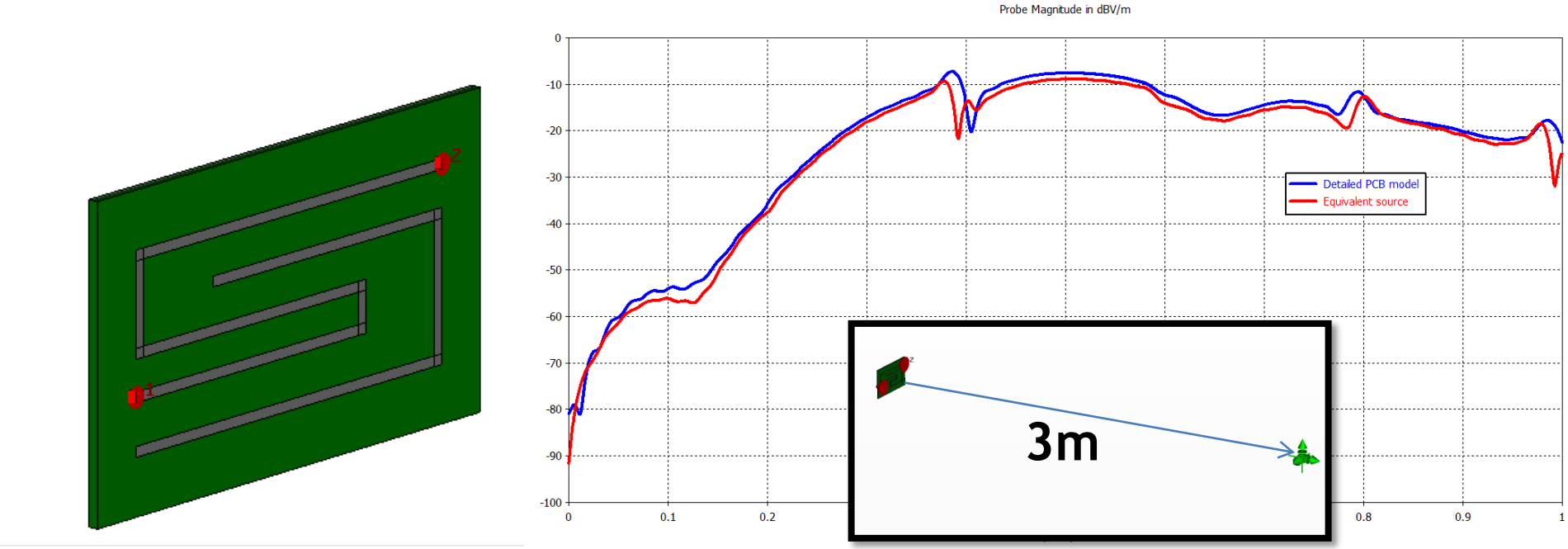
Near-field source region



Source magnetic fields at 1 GHz

Far-Field Prediction

- Simulation could include large scale effect like cables, enclosures, etc.



Conclusion

VERY-NEAR-FIELD ARRAY BASED MEASUREMENT

Very-Near-Field Pros and Cons

- Strengths
  - Continuous peak hold scan for spurious events
  - Real-time view of emission sources and currents
  - Fast pre-compliance regulatory data

- Limitations
  - PCB diagnostic not product compliance
  - DUT no bigger than scanner for pre-compliance
    - Any size for diagnostic
  - Mezzanine PCB might need disassembly for testing

Exciting Value Proposition

Substantially **Reduce** Project Development Costs

Dramatically **Increase** Designer Productivity

Significantly **Accelerate** Time-to-Market

1 Hour in a Chamber or **1 Second** with a Scanner?

Thank You

If you are interested in testing your PCB on the EMxpert system for free please contact us at

www.emscan.com

info@emscan.com

Thanks for attending!

Don’t miss our Test Bootcamp!
November 16, 2016
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