


EMC/EMI Testing in Less Than One Second Using Very-Near-Field Techniques



Agenda

- Introduction to Very-Near-Field
- Very-Near-Field Implementation
- Very Near-Field Benefits
- Far-Field Prediction
- Other Applications
- Conclusion




Introduction to EMSCAN

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




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



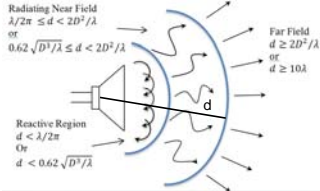

Introduction to Very-Near-Field

Far-Field / Near-Field / Very-Near-Field





What is Very-Near-Field?

- What we call the very-near-field is the reactive region
- Interaction with device under test is unavoidable
- These are rules of thumb only



Far-Field Measurements cont.

- Controlled environment
- Anechoic or semi-anechoic chamber
- High capital and operating expenses
- Queues often form to get time in chamber

Very-Near-Field Measurements

- Origin of all emissions
- Insight into root causes
- Best applied at board level
- Extrapolate far-field from very-near-field



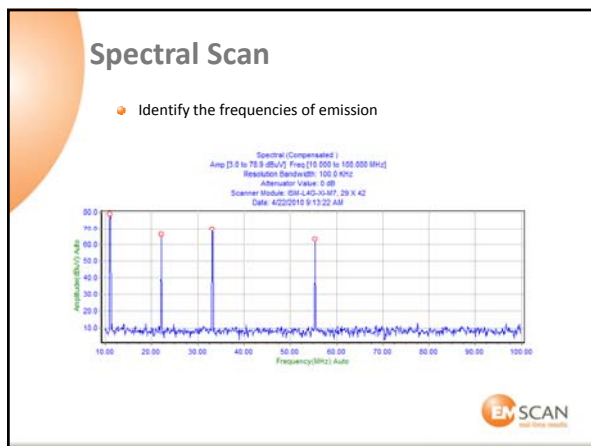
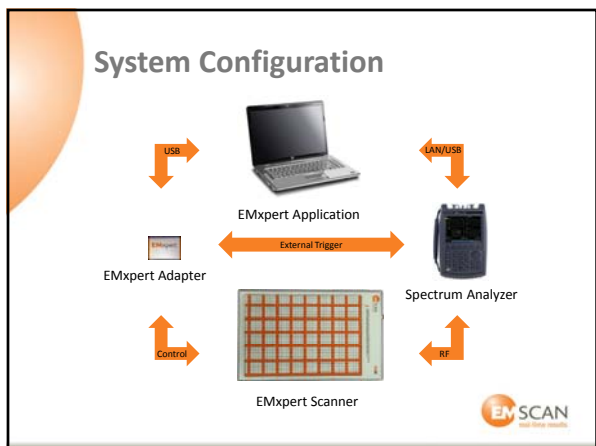
Very-Near-Field Implementation

A Better Solution



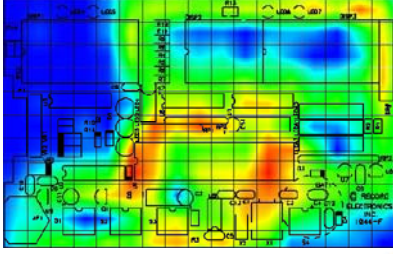
Powerful Scanner

- 1218 probes in a 29 x 42 array
- Magnetic field loop probes
 - Sensitive down to -135 dBm
 - Inefficient for EMI Isolation
 - Broadband
 - 50 kHz to 4 GHz
 - 150 kHz to 8 GHz
- 3.75 mm to 0.12 mm resolution
- Scan area 21.8cm x 31.6cm
- Isolated case for safe testing
- Real-time measurements (< 1 sec)






Spatial Scan

- Visualize where the emissions are coming from




The image shows a top-down view of a printed circuit board (PCB) with a color-coded heatmap overlaid. The colors range from blue (low emission) to red (high emission), indicating the spatial distribution of electromagnetic emissions across the board's components and traces.



A Real Time Scanner

Demonstration



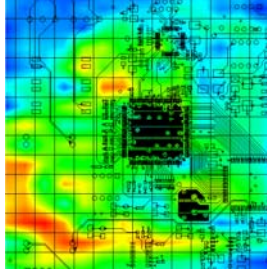
A Real Time Scanner

Benefits of Very-Near-Field Testing




Real-Time

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

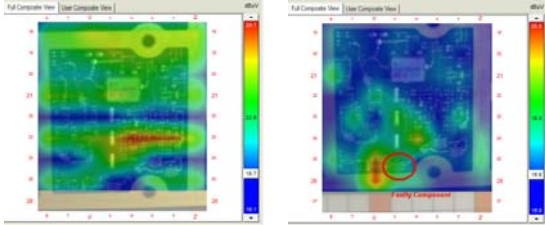


The image displays a real-time scan of a PCB, showing a dynamic heatmap that changes as the board is tested. The color scale indicates the intensity of emissions, with red and yellow areas representing higher emission levels.



A/B Comparison

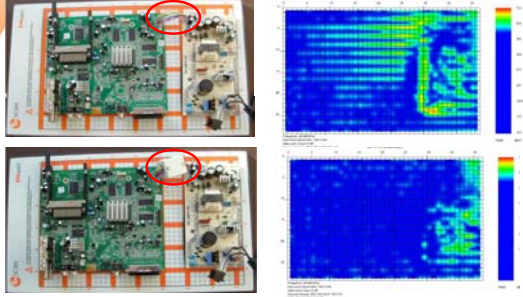
- Obsolescence management
- Production unit versus gold standard
- Fault diagnosis



The image shows two side-by-side heatmaps of a PCB, labeled 'Full Composite View' and 'A/B Comparison'. The 'A/B Comparison' view highlights differences between two units, with a red circle indicating a specific area of interest.

Effectiveness of Filters

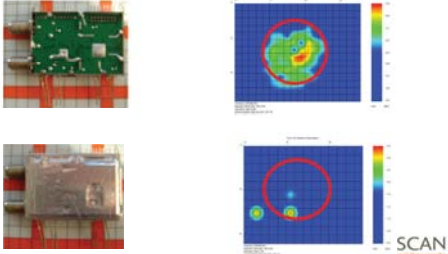
- Immediate feedback means trial and error can be used



The image displays two rows of images. Each row contains a photograph of a PCB with a red circle highlighting a component, and a corresponding heatmap to its right. The heatmaps show the emission patterns before and after filtering, demonstrating the effectiveness of the filters in reducing emissions from the highlighted component.

Testing Shielding or Absorbers

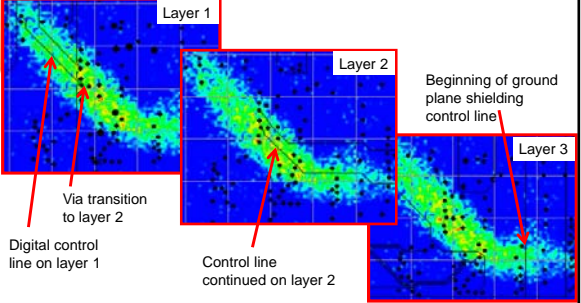
- Look for leakage points or introduction of new radiation mechanisms
- Test uniformity and effectiveness



SCAN

High Resolution Scanner - ERX+

- Hybrid mechanical array solution can measure with 0.12mm resolution
- Able to follow the signal on the traces as it goes between layers.




SCAN

Pre-Compliance Testing

What about Far-Field?

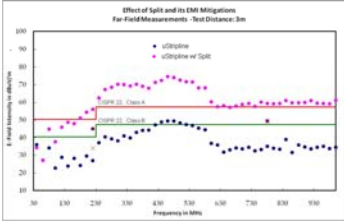


Correlation between VNF and FF




Case Study

- PCBs containing split planes on ground plane fail EMI requirements more often than those without

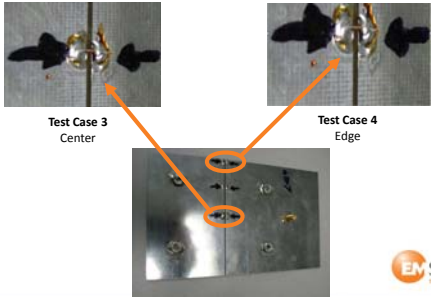



Measured at DVT Solutions in Calgary, Canada



Cases 3 to 4: Shorting Jumper

- Splits in ground are repaired with different grounding points or with capacitive connection

Shorting Jumper

- Split ground effect is easy to visualize
- Mitigation can be guided without chamber measurements

The figure displays four heatmaps illustrating the electromagnetic field distribution on a PCB with a jumper. The top-left heatmap is labeled 'Solid Ground' and shows a uniform field. The top-right is 'Split Ground', showing a field concentrated in the center. The middle-right is 'Jumper Center', showing a field concentrated at the center of the jumper. The bottom-right is 'Jumper Edge', showing a field concentrated at the edges of the jumper. Each heatmap includes a color scale from blue (low) to red (high).

Predictive Application

Far-Field Prediction

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

The graph plots 'Far Field Levels in dBm' on the y-axis (ranging from -10 to 100) against 'Frequency in MHz' on the x-axis (ranging from 0 to 2000). It shows a series of data points connected by lines, with a red line representing the predicted levels and blue dots representing measured levels. The predicted levels generally follow the measured levels, showing a peak around 100 MHz and then a gradual decline with some fluctuations. Below the graph is a table of parameters and settings.

Methodology

- Measure very-near-field emissions and apply a model based prediction algorithm to them
- Some user expertise is still needed

The methodology flowchart consists of a sequence of steps: EMxpert, Export, Correct, Import, Model, and Transform, leading to the final output 'FF'. Each step is represented by an orange box with a right-pointing arrow. Below the flowchart, a double-headed orange arrow indicates a duration of '10 to 30 minutes'.

Far-Field Prediction

- World's fastest pre-compliance
 - FCC/ANSI, CISPR and user-defined limit lines

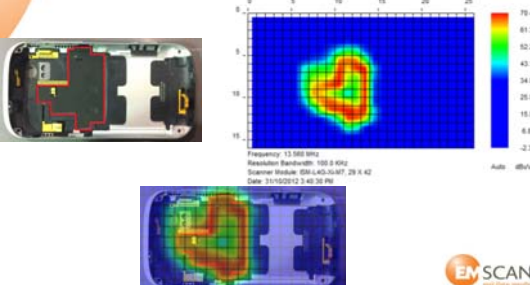
The diagram shows a heatmap of a PCB on the left, with an orange arrow pointing to a far-field prediction graph on the right. The graph plots 'Far Field Levels in dBm' against 'Frequency in MHz', showing a series of data points and a red line representing the predicted levels. The graph also includes a table of parameters and settings.

Other Applications

Beyond EMC

NFC Antennas

- Measure the field strength at specific distances

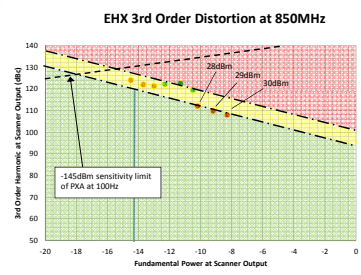


Frequency: 13.562 MHz
 Resonance Bandwidth: 100.0 kHz
 Scanner Model: EMSCAN-3047, 28 A, 42
 Date: 11/10/2013 3:42:30 PM

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Distortion and PIM Testing

- Scanner linearity can be better than -120dBc



EHX 3rd Order Distortion at 850MHz

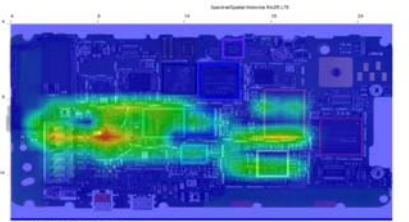
Legend:
 • Vivaldi EHX
 • Dipole EHX
 • Patch EHX

-145dBm sensitivity limit of PKA at 100Hz

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Measure Self-Interference (Desense)

- Sensitivity of the system can detect emissions from a conducted power as low as -135dBm



Noise generated at 1575.039 MHz while camera is active harms GPS performance

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Conclusion

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Very-Near-Field = Magic Goggles



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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

EMSCAN

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

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