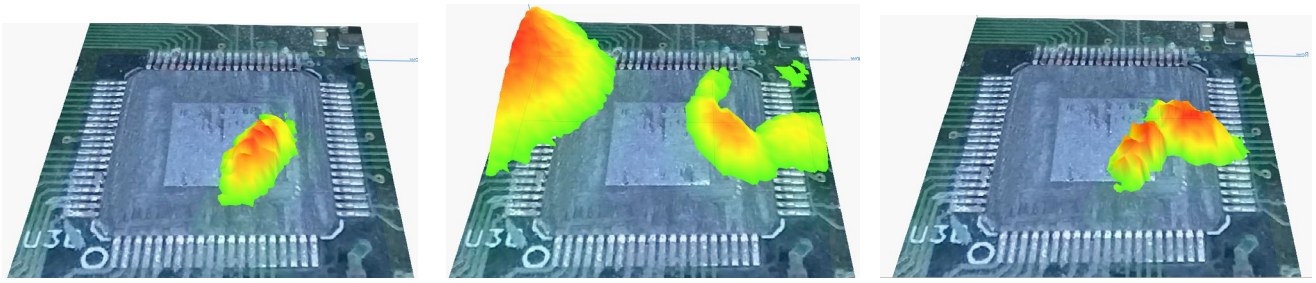
EMSCAN
real-time results

Speed Meets Accuracy in a New EM Scanning Technique

How to pinpoint emissions in minutes, even from within an integrated circuit

by Ruska Patton, Director, Product Management

EMxpert ERX+ test results showing emissions from inside an IC



100 MHz | 120 MHz | 130 MHz

EMxpert

How to Pinpoint Emissions in Minutes, Even From Within an Integrated Circuit

Introduction

For designers of electronics such as integrated circuits and circuit boards, electromagnetic emissions are a critical concern. Designers need to ensure the final products comply with international standards for controlling radiated emissions. They must also take care that a product does not cause self-interference or interference with other devices when working as part of a larger system.

If electromagnetic interference (EMI) and compatibility (EMC) problems are not detected and fixed early in the design process, consequences can include production delays, missed time-to-market goals and higher costs. To correct problems early, they must be identified before compliance testing, and with details that standard far-field compliance testing cannot provide. Far-field measurements indicate whether a device has passed or failed, but do not add much value for discovering the root causes of an emissions issue.

For this reason, very-near-field tools capable of pinpointing problems are essential to designers and verification engineers—and the faster and more accurate the tools, the better.

Limitations of Today's Methods

However, most available tools emphasize either high speed or high precision, not both. Traditional very-near-field measurement with a handheld probe is useful for finding sources of emissions. By moving the probe to various points on a circuit board, the user can find hotspots related to any emissions problem. But this method doesn't provide an overall picture of the board, so it can miss some potential sources of emissions. Robotic positioners can individually scan all the various features where emissions might occur with high precision, but they can take hours.

A much faster method is to use a scanning array that applies multiple probes at once, enabling the user to measure a whole board or section of a board in less than a second. It is not only faster, but ultimately repeatable. On the other hand, the fixed distance between the probes in the array means this method may not be effective for obtaining very fine detail and isolating the precise source of an emission.

Combining the Best of Both Worlds

Now, a new scanning technique is available that delivers both speed and accuracy, with the ability to precisely pinpoint emissions even from inside an integrated circuit or microchip in just minutes. The EMxpert™ ERX+™ product from EMSCAN™ effectively provides higher resolution by combining a 1,218 probe array with a fine and precise mechanical motion. A robotic positioner moves the entire array methodically to fill in the distance between probes. This technique increases the density of points measured, up to 4,000 times the number of points, by dividing the scanned area into tighter and tighter grids according to user settings (Figure 1).

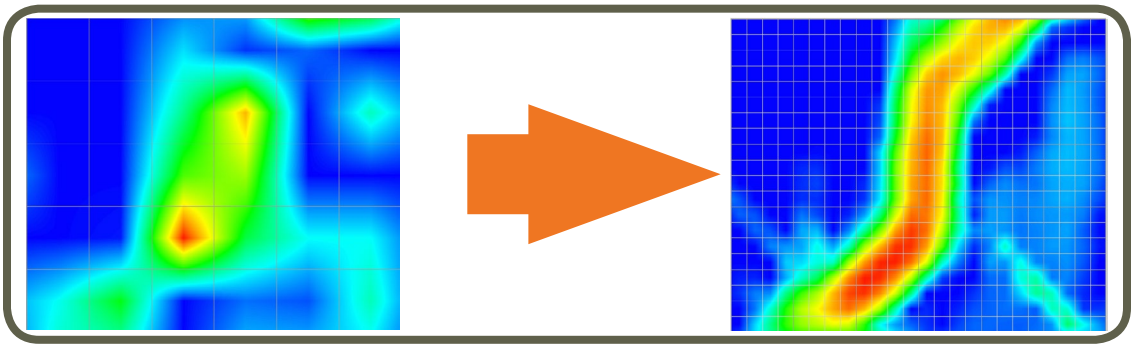


Figure 1. EMSCAN EMxpert ERX+ spatial scans at level 1 (left) and level 3 (right)

The ability to increase density makes a significant difference in the resolution of the spatial image provided by the scan. For example, changing from a level 1 scan to a level 8 scan, the highest density setting, reduces the effective space between measurement points from 7.50 mm to just 0.06 mm. Details of small features become available, even inside components.

Analyzing a PCB With the EMxpert ERX+

The EMxpert ERX+ scanner enables a designer or engineer to very quickly sample the magnetic field distribution of a product and visually display the results. The solution uses an embedded spectrum analyzer and intuitive visual imaging to provide both a spectral view to identify the frequencies of emission and a spatial view to visualize where

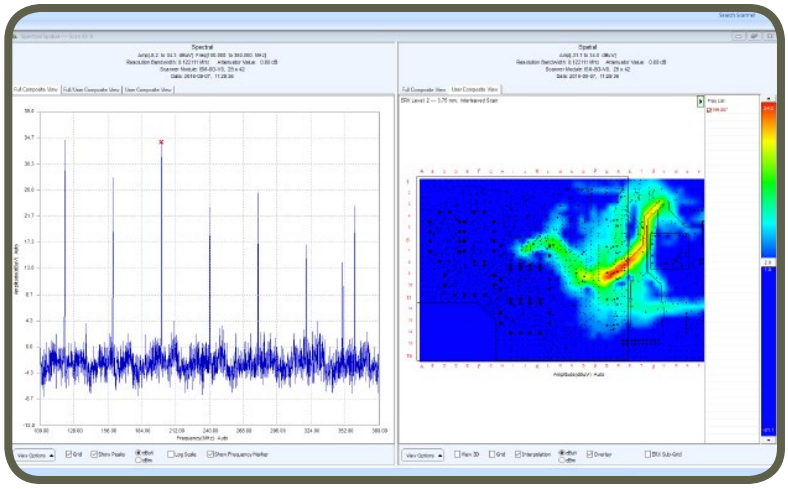


Figure 2. Spectral (left) and spatial (right) views of a scan

A quick scan typically identifies many emissions. The designer can use the EMxpert ERX+ software, which is highly interactive, to jump around the board, zoom in and isolate emissions by location or frequency. Overlaying a design file, like a Gerber file, of the board onto the spatial view makes it easy to correlate energy shown in the display to specific circuit board features such as ICs, power planes and control lines (Figure 3). For multilayer boards, the user can display added layers to follow emissions coming from a trace that starts on one layer and continues deeper.

If currents move onto an internal layer that is shielded, there will be no fields in the external environment for the EMxpert ERX+ to measure. In this case, the currents are not relevant to a radiated emissions problem. If the shielded feature is the root cause of emissions leaking out of holes in the shield or at the board edge, the scanner will be able to measure it.

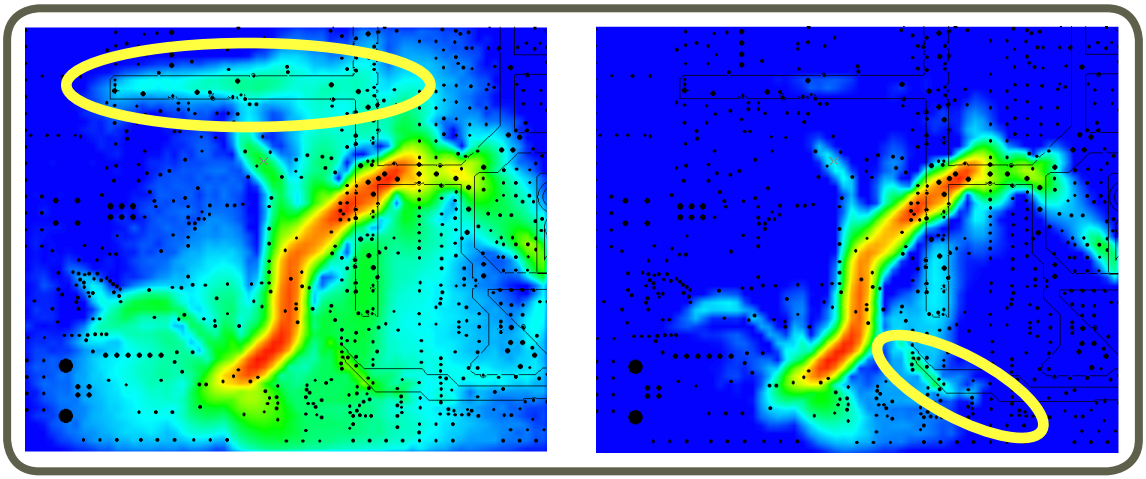


Figure 3. Energy coupled onto power plane (left) and control line (right)

Viewing Emissions From Inside an IC

The extremely high resolution of the EMxpert ERX+ scanner enables it to peer inside an IC and isolate the radiation from individual pins and wire bonds at different frequencies. The system software can also import images when design files are not available. Spectral and spatial views can be combined to provide a three-dimensional image of emissions. Looking inside an IC, it is possible to see the sources of radiation—whether it is coming from the die region itself, from some of the pins on the IC, or spilling onto the IC from a different portion of the board (Figure 4). By using this information along with knowledge of the IC design, the user can come up with solutions to emissions problems.

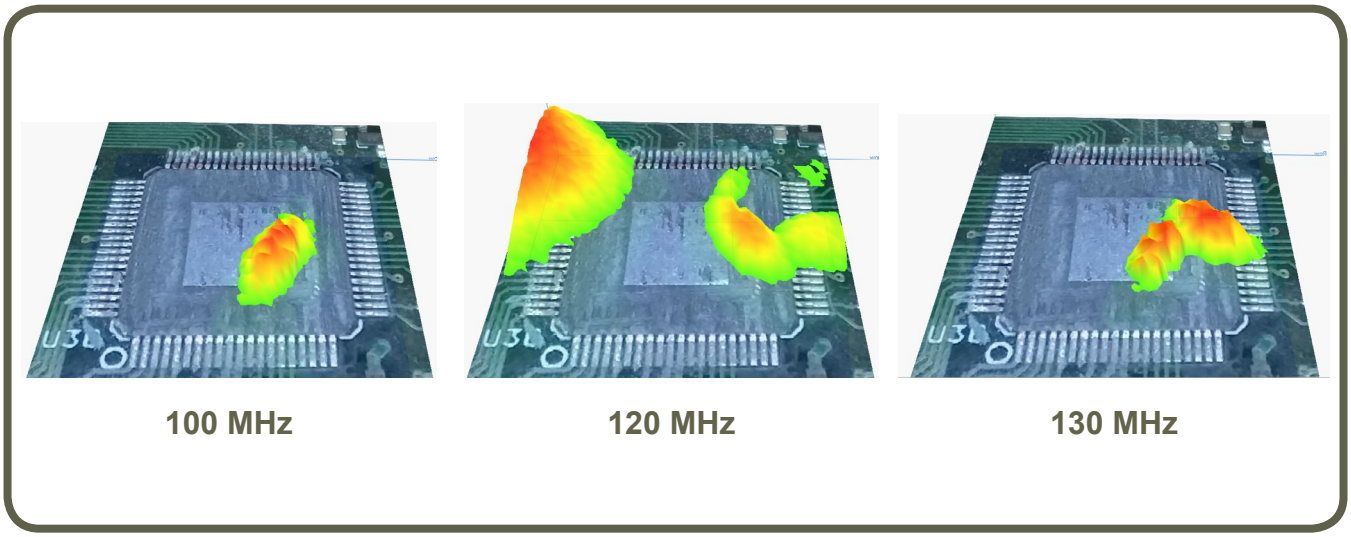


Figure 4. Views of IC emissions at various frequencies

Helping to Improve Software Simulations

With the EMxpert ERX+, organizations can also overcome one of the most difficult problems for software simulation today. They can use simulation to model a system and predict the radiated emissions. But in some cases, the complexity of the design makes this approach impractical due to setup and computational constraints. Or, due to intellectual property concerns, detailed design files may not be available. In these cases, it can be useful to measure the emissions from the most complex part or the hidden portion of the system using the EMxpert ERX+ and import these measured fields into the simulation as a “black box.” These imported fields can then be simulated along with larger but less complex features to estimate the radiated emission from the entire system.

Predicting EMC Compliance

Very-near-field measurements with the EMxpert ERX+ are an excellent PCB diagnostic, but are not sufficient for product compliance. The product will still need to pass standard far-field compliance tests in a testing chamber. However, organizations can use the EMxpert ERX+ results to predict whether a device will pass the chamber tests or not. This far-field prediction capability estimates the results that would be obtained from a given board if it was tested in a compliance setup, and the predicted results have been shown to track closely with the actual results. If a device is predicted to fail, changes made in the lab can then be validated using far-field prediction before going to the chamber.

Conclusion

Together, the capabilities provided by EMxpert ERX+ add up to faster time to market, reduced project costs and increased productivity for electronics companies. EMxpert ERX+ presents real-time scans in seconds to identify spurious and continuous EM emissions. The instrument provides spatial and spectral scans that allow design teams to cut one to two design cycles out of their product development process. It also reduces their EMI testing time by up to two orders of magnitude.

Design teams can conduct scans on the EMxpert ERX+ system in their offices and obtain results in a matter of minutes. To test a new design in a third-party chamber could require that an engineer travel to an offsite test facility for the better part of a day after potentially waiting days or weeks for a chamber to become available. The spatial and spectral scans provided by the system also improve the ability to document new features and can be key elements in product marketing, giving customers graphic proof of a product's EMI characteristics.

The EMxpert ERX+ represents a new step forward in plug-and-play, high-resolution EMC and EMI testing, enabling designers to rapidly diagnose and solve emission problems in a single design cycle from the convenience of their own environment.

About the Author

Ruska Patton MBA, M.Sc. is responsible for the evolution of EMSCAN's real-time very-near-field measurement solutions. Having started with EMSCAN as Design Engineer and then Manager of the Design Group, Mr. Patton now leads the development of new EMSCAN solutions from concept through to successful products in market. Mr. Patton has authored academic papers, presented seminars and holds several patents related to near-field scanning.

About EMSCAN

EMSCAN is the world leading developer of FAST magnetic very-near-field measurement technologies and applications since 1989, providing real-time test solutions to antenna and PCB designers and verification engineers, without the need for a chamber. The EMxpert, a compact EMC and EMI diagnostic tool, and the RFxpert, an antenna measurement tool, enable engineers to quickly optimize their designs. EMSCAN solutions dramatically increase designer productivity and substantially reduce time-to-market and project development costs.

www.emscan.com

For more information contact us:

EMSCAN Global Headquarters:

#1, 1715, 27th Ave. N.E.

Calgary, Alberta, Canada, T2E 7E1

Phone:

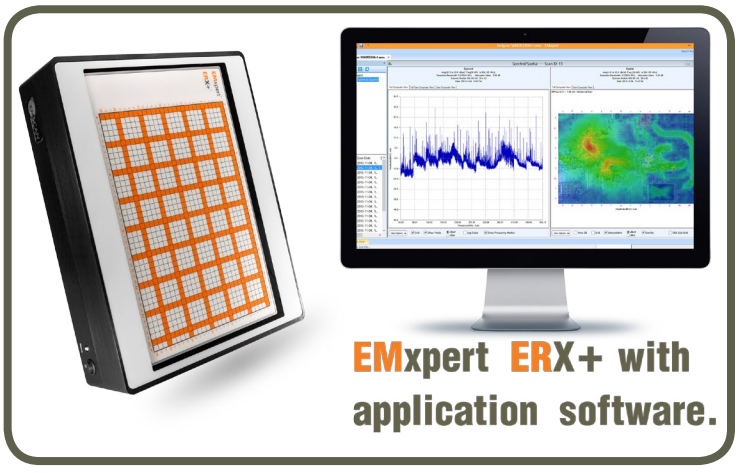
+1-403-291-0313

North America Toll Free:

+1-877-367-2261

Email:

info@emscan.com



ERX+ Features

Capability	Spectral scan, spatial scan, peak-hold, continuous scanning, spectral and spatial comparison, scripting, limit lines, report generator, notes
Spatial scan time	Continuous real-time for entire scan area when Level 1 selected Level 1: 20 sec. (Selected area entire scanner, 1,218 probes activated) Level 2: 5 sec. (Selected area 2.25 cm x 2.25 cm, 9 probes activated) Level 3: 5 sec. (Selected area 2.25 cm x 2.25 cm, 9 probes activated) Level 4: 20 sec. (Selected area 2.25 cm x 2.25 cm, 9 probes activated) Level 5: 1 min. 10 sec. (Selected area 2.25 cm x 2.25 cm, 9 probes activated) Level 6: 4 min. 30 sec. (Selected area 2.25 cm x 2.25 cm, 9 probes activated) Level 7: 18 min. 00 sec. (Selected area 2.25 cm x 2.25 cm, 9 probes activated)
Spectral scan time	5 seconds for L 10 cm x W 10 cm (L 4” x W 4”) PCB with a 100 MHz span and 120 kHz RBW. Scanning area, span and RBW are user selectable within spectrum analyzer specifications
Supported operating systems	Windows 10®, Windows 8®, Windows 7®, Windows Vista® and Windows XP®
Supported overlays	Picture in JPEG format Standard Gerber© RS274x and HPGL CAD files

ERX+ Scanner Specifications

Broadband frequency coverage	150 kHz to 8 GHz Base configuration (3-year warranty) 150 kHz to 8 GHz (Part #: 3000-2805) Alternate configuration (5-year warranty) 150 kHz to 8 GHz (Part #: 3000-2806)
Antenna array	1,218 (42 x 29) H-field probes
Spatial resolution	Level 1: 7.50 mm Level 2: 3.75 mm Level 3: 1.88 mm Level 4: 0.94 mm Level 5: 0.47 mm Level 6: 0.24 mm Level 7: 0.12 mm
Scan area	L 31.6 cm x W 21.8 cm (L 12.44” x W 8.58”)
Frequency accuracy of peaks	Peak marking accuracy of spectrum analyzer
Probe to probe uniformity	Calibrated before shipment. Firmware correction factors adjust for frequency dependant probe responses with +/- 3 dB accuracy
Measurement plane isolation	> 20 dB
Maximum radiated power load	10 W / 40 dBm
Scanner connections	PC: Ethernet
Enclosure	Anodized non-conductive metal
Dimensions of the scanner	L 34.5 cm x W 43.5 cm x H 11 cm (L 13.58” x W 17.13” x H 4.33”)
Weight	12.70 Kg / 28 lb. (including cables and the adaptor)
Power requirements	12 VDC, 3.33 A

EM SCAN real-time results

#1, 1715-27 Avenue NE
Calgary, AB T2E 7E1
Canada

Tel: +1-403-291 0313
Fax: +1-403-250 8786

www.emscan.com

EM/WP/ERX+/v2 05.17