EMScanner

User Manual

V01/0912

EMScanner

High speed real-time EMC/EMI Diagnostic tool
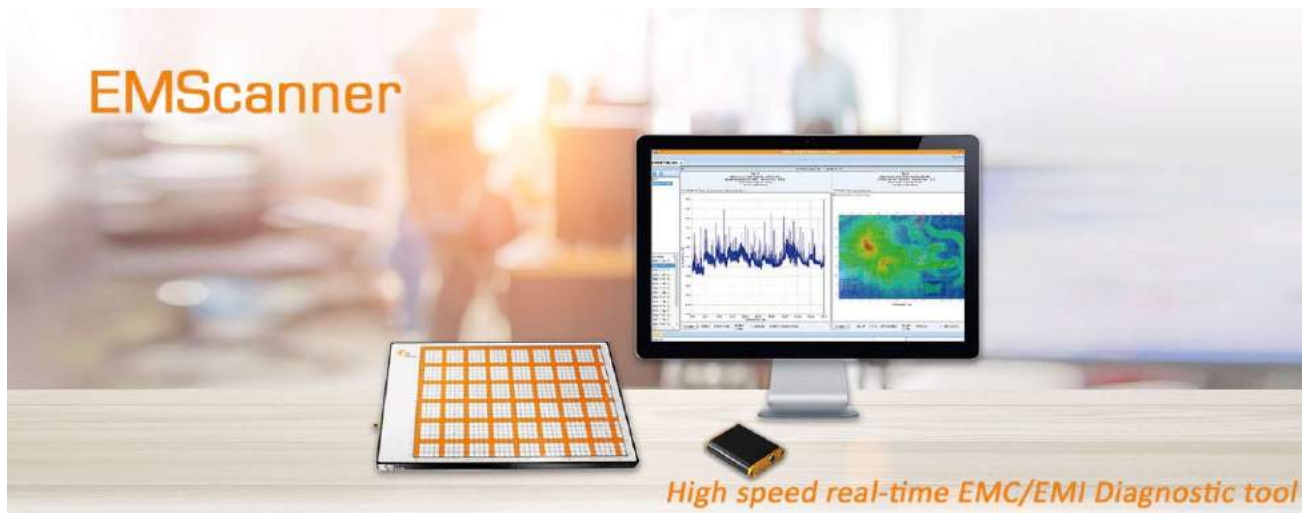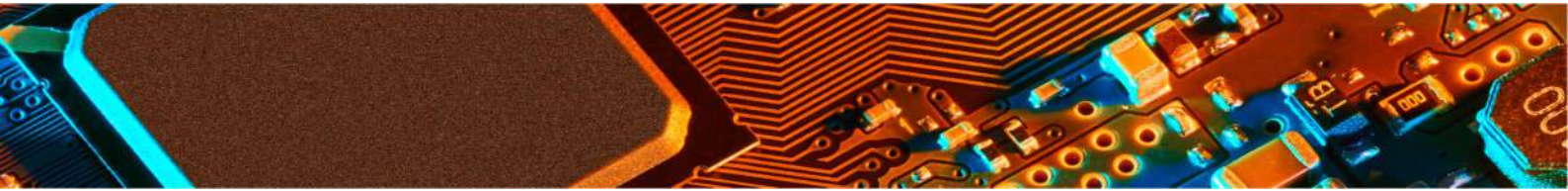
www.yictechnologies.com

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Warranty

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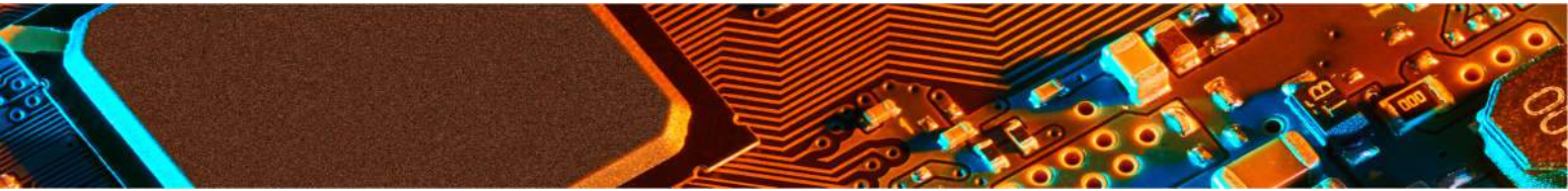
Safety Notices

Caution

A CAUTION notice denotes a hazard. It calls attention to operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

Warning

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

About the EMScanner Products

EMScanners product family provides board-level design teams with world-leading fast nearfield magnetic data to help diagnose EMC design issues.
EMScanner product line consists of **EMScanner, EMScannerR+** and **EMProbe**, these instruments
capture and display visual images of spectral and spatial scan results in seconds. This allows the design team to immediately analyze and compare design iterations.
PCB designers can scan any board to identify both constant and time-based emission sources in the range of 150 kHz to 8 GHz.

EMScanner consists of a patented scanner and a compact adaptor, a customer-supplied spectrum analyzer and a PC running **EMViewer** software. Free Keysight IO software application must also be installed on the customer-supplied PC. The patented scanner consists of an array of 1,218 H-field (magnetic) probes spaced every 7.5 mm which provides an effective 3.75 mm resolution. The system operates from 150 kHz to 4 GHz and from 150 kHz to 8 GHz with upgradable and optional software license key.

EMScannerR+ is a self-contained high resolution near-field scanning device. Simply connect the **EMScannerR+** to the PC and to a spectrum analyzer, install the **EMViewer** software on the PC and begin measurements. The system operates from 150 kHz to 8 GHz. The **EMScannerR+** provide 0.06 mm incremental measurement steps.

EMProbe is a repeatable high resolution EMC and EMI diagnostic with hand held hear field probes. Different types of Robotic Arms can be used, based on the desired size and resolution.

Minimum System Requirements

- CPU 333 MHz or faster
- 256 MB RAM recommended
- 8 MB Video or more
- Windows 10 OS
- 10/100/1000 LAN port
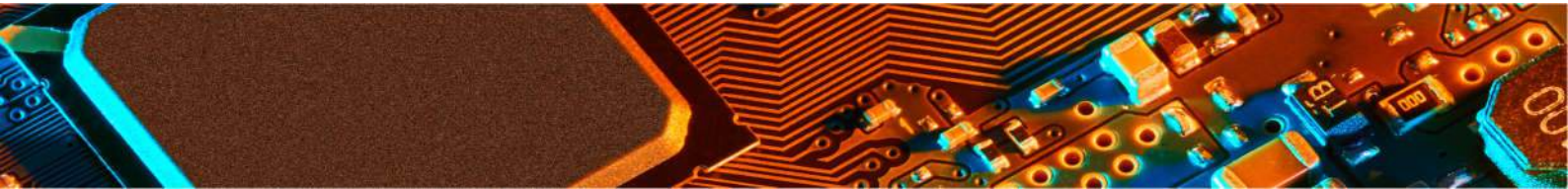- 1 or 2 USB1.0 or USB 2.0 ports
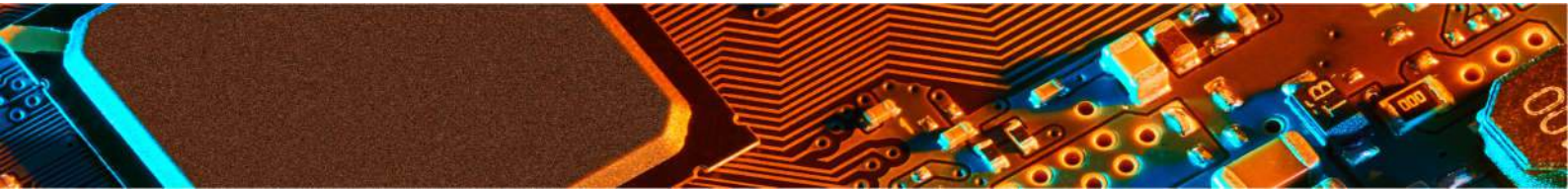
Technical Support

To help us provide fast and seamless technical support, kindly gather the following information and contact Technical Support as instructed further below:
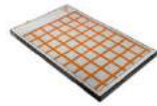
1. Serial number of your unit.
2. Software and firmware versions:
3. Windows OS information
4. Keysight IO version
5. Spectrum analyser model and firmware level
6. Information View data saved as a text file
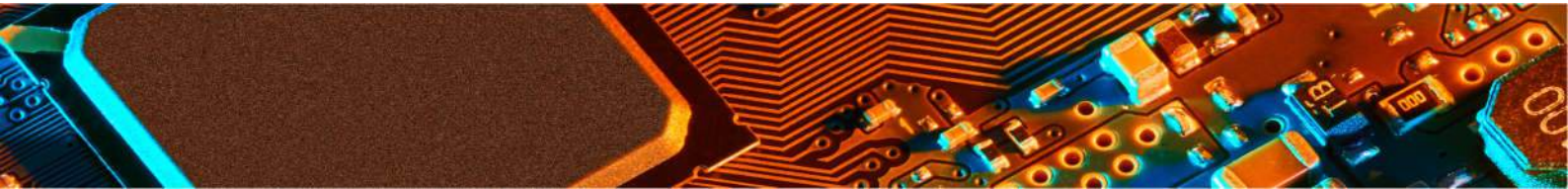7. Description of the problem including screen shots and videos

Y.I.C Technologies
+44 (0) 01252 661036
support@yictechnologies.com

Cables & Component Checklist

Components Supplied with the EMScanner System

1	Scanner board	EMScanner	
2	Adapter	The adapter controls the EMScanner	
3	RF SMA to type N coaxial cable	It is referred as the RF cable in this manual. It connects the scanner to the spectrum analyser and has a SMA connector for the scanner and a N connector for the spectrum analyzer 50 ohm input port. It transmits RF output of the scanner to the spectrum analyser.	
4	Micro-D control cable	It connects the adapter to the scanner to enable control of the scanner's switched probes and to power the scanner.	
5	USB Cable	It connects the PC (laptop or desktop) to the adaptor. The USB Cable provided with the system has ferrites on both ends of the cable	
6	SMB-BNC Trigger Cable	It connects the adaptor to the spectrum analyser	

Customer Provided Components

1. <u>Spectrum Analyzer:</u> It must include the necessary options to work with the **EMScanner** (see Supported Spectrum Analyzers). It measures the radio frequency (RF) signal received from the **EMScanner**, generated by the very-near-field emissions of an adjacent activated PCB and it outputs the data to the PC.
Most Keysight`s and R&D`s models are supported.

2. <u>PC (Laptop / Desktop):</u> It must support a LAN 10/100 connection to the spectrum analyzer and a USB connection (version 2.0 or higher) to the adaptor or two USB connections, one for the spectrum analyzer and one for the adaptor. It runs the EMViewer software and receives data, which it can display and manipulate immediately or store for future data presentation.

> **Note:**
>
> Spectrum Analyzer, Personal Computer (PC) connected with Ethernet cable must comply CE emission requirements

Options & Accessories

| 1	**BW Upgrade**	- From 150KHz - 4GHs to 150KHz - 8GHs
2	**Calibration**	- Calibration and testing - Software and Firmware updates
3	**Customer Care Package**	- Calibration and testing - Software and Firmware updates - Standard parts & labour warranty

Installation & Hardware Setup

1. Install latest version of Keysight IO
Click here to open the website to download the latest version. On the website click on the Download button and follow the steps.

2. Install the software application
   a. Install the EMViewer software by clicking on the Setup application icon. The application must always be installed on the C: drive.
   b. EMViewer software can be found at www.yictechnologies.com

3. Connect PC, scanner, adapter and spectrum analyzer as per the diagram below. If you are using Ethernet between the PC and the spectrum analyzer, use a crossover Ethernet cable.

If the spectrum analyzer has multiple trigger ports, always connect to Trigger 1 IN.

Connection Diagram
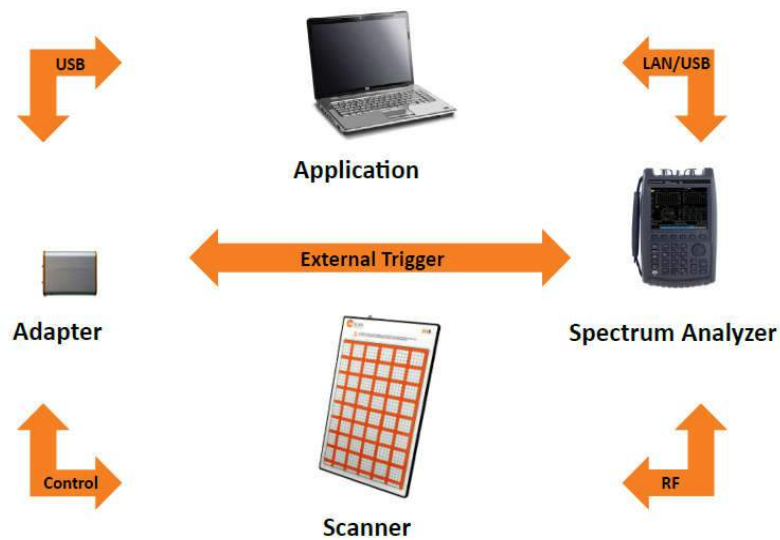
Hardware Setup

1. Connect the SMB connector to the Adapter and the BNC connector to the external trigger port on the rear panel of the spectrum analyser

2. Connect the B-end of the USB cable to the USB port on the Adaptor and A-end to any USB port on the computer.
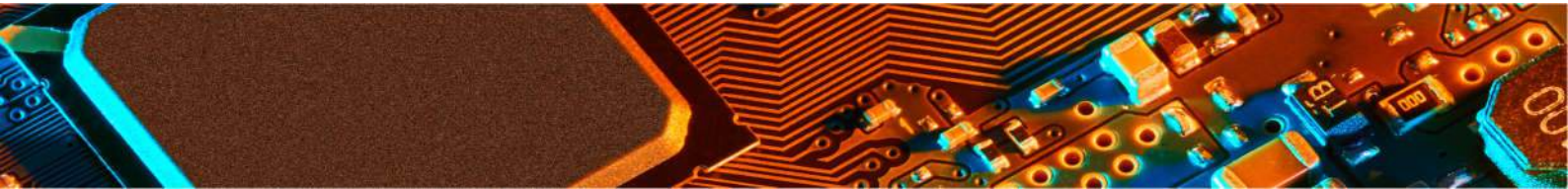

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EMScanner and Adapter ports

1. SMB external trigger cable port
2. LED light shows three stages:
   Red: Boot mode (this stage is fast; you may not even notice it)
   Orange: Initiation mode (checking adaptor's firmware)
   Green: User mode (adaptor is connected and ready)
3. USB connection port
4. Micro-D control cable connector - Adapter
5. Micro-D control cable connector – Scanner

6. RF output port
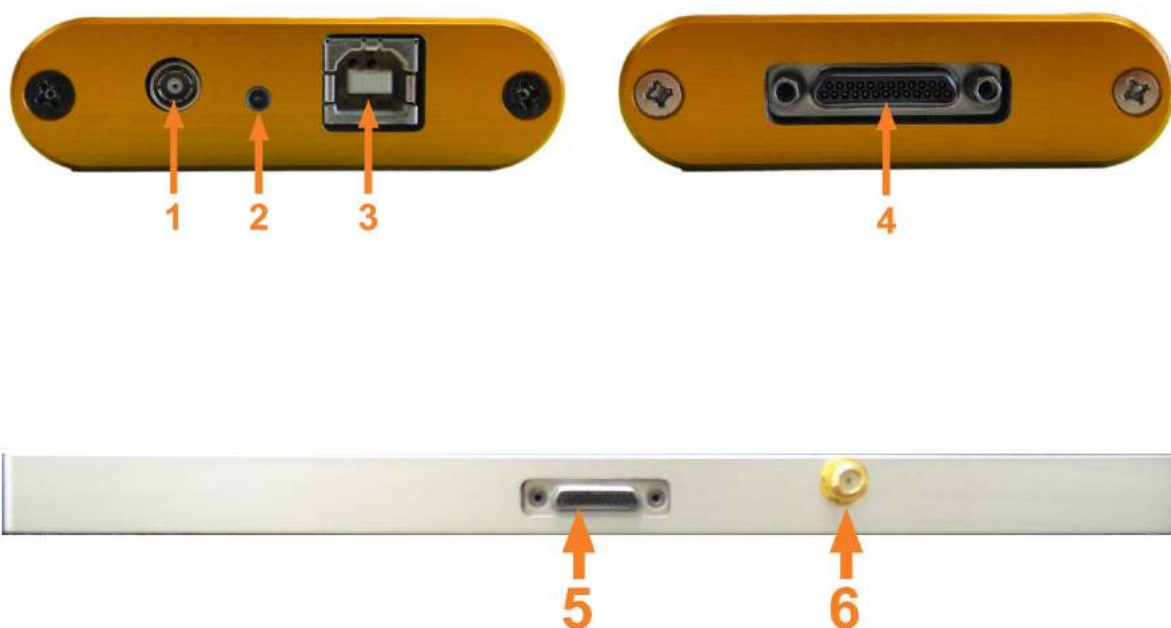
If your **EMScanner** still does not work, then please contact
support@yictechnologies.com

Software Installation

1. Plug-in the **EMScanner** USB drive. Select the software folder and double click on Setup.exe file
2. When you are prompted "Do you want to allow the following program from an unknown publisher to make changes to this computer" click Yes
3. Click Next
4. Click Next
5. Select I Agree and click Next
6. Below screen will be displayed
7. Click Close
8. If Keysight IO Library is already installed on your PC, you can start using **EMScanner** software. Otherwise please follow the next steps to install it. You need an internet connection to download Keysight IO Library.
9. Once you are directed to the Keysight website click on the Download button and follow the steps. When the download is complete, open the Downloads folder and double click IOLibSuite_xxx.
10. The folder will be unzipped.
11. Click Next
12. Select Agree and click Next
13. Select Typical and click Next
14. Click Install
15. If Microsoft Visual C++ is not installed on your PC below screen will be displayed. Click Yes
16. While the software is installing, the following screen will be displayed.
17. Click Finish
18. Connect the USB Cable to the **EMScanner** adaptor and PC
    a. The driver will be automatically installed
    b. If the installation doesn't start automatically, follow below steps. Open the Device Manager and expand "USB Custom Driver" and right click on **EMScanner** USB Driver (C) 2014 and select Update Driver Software
    c. Select Browse my computer for driver software
    d. Select Include subfolders and click Browse and select the **EMScanner** USB drive and click OK
    e. Click Next
    f. Click Close to complete installation
19. Start the **EMScanner** Software by clicking the icon on the Desktop

External Spectrum Analyzer Setup

Attention: An ethernet cross-over cable (static IP must be set for PC and the analyzer) or USB cable can be used for the PC and spectrum analyzer connection.

USB Connection
If the PC and spectrum analyzer are connected via USB cable skip to Step 2
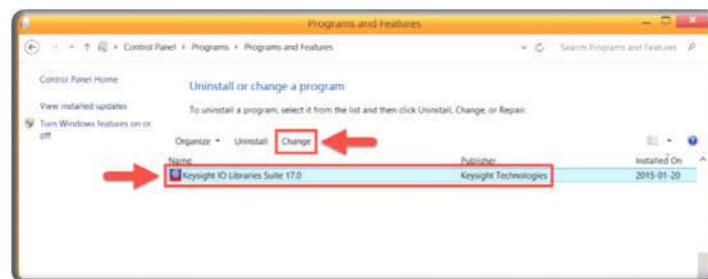
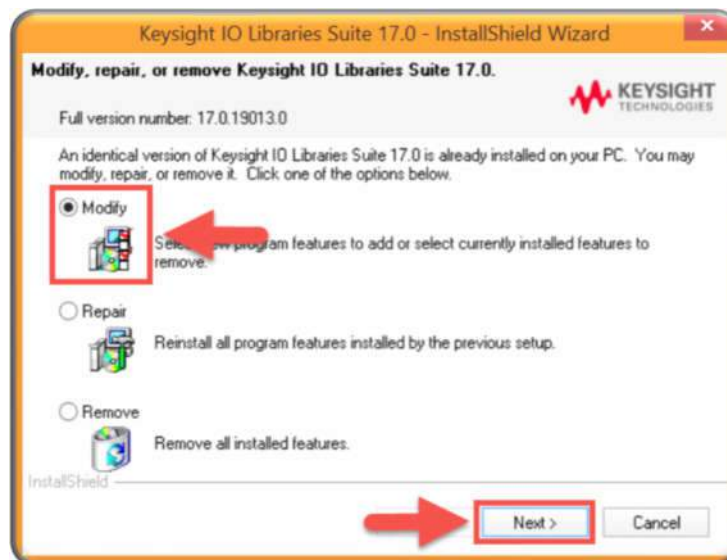**LAN Connection**

Step 1 - Spectrum Analyzer Setup
- In order to make Technical Support easier, the IP address of the analyzer must be set to the default IP 172.16.1.148 and the PC's at 172.16.1.99.
- Please check Technical Bulletin #9 if you have a Keysight spectrum analyzer.
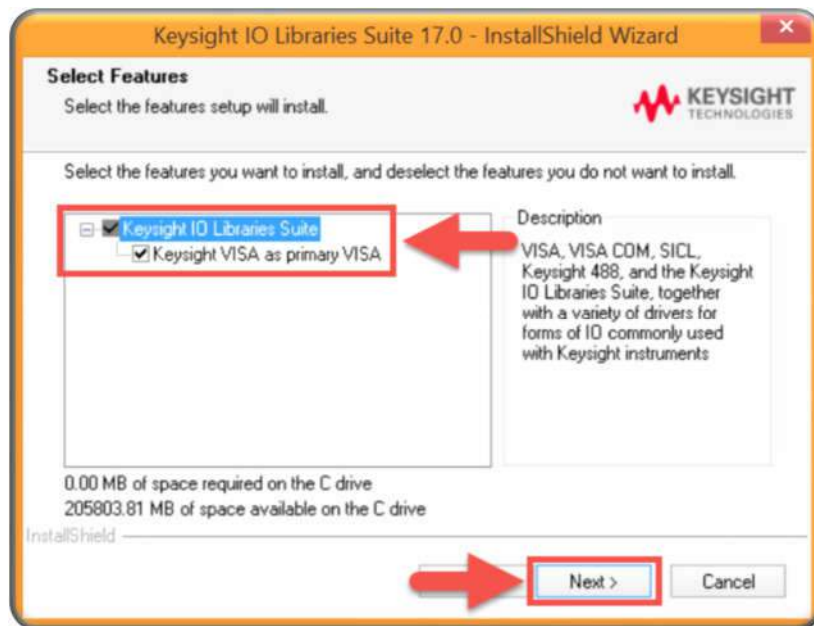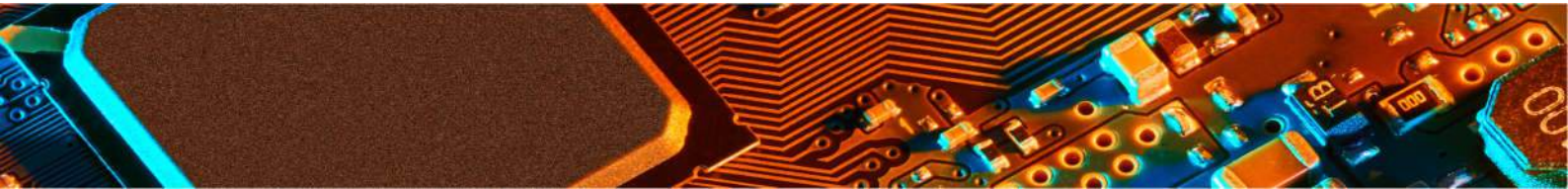
Step 2 - PC Setup
- Several visa libraries may already be installed on the PC. Ensure that Keysight Connection Expert is set as primary VISA
- Go to Control Panel and double click Add or Remove Programs
- Select Keysight IO Libraries Suite and click Change


• Select Modify and click Next


• Select Keysight Visa as primary VISA and click Next

• Click Finish

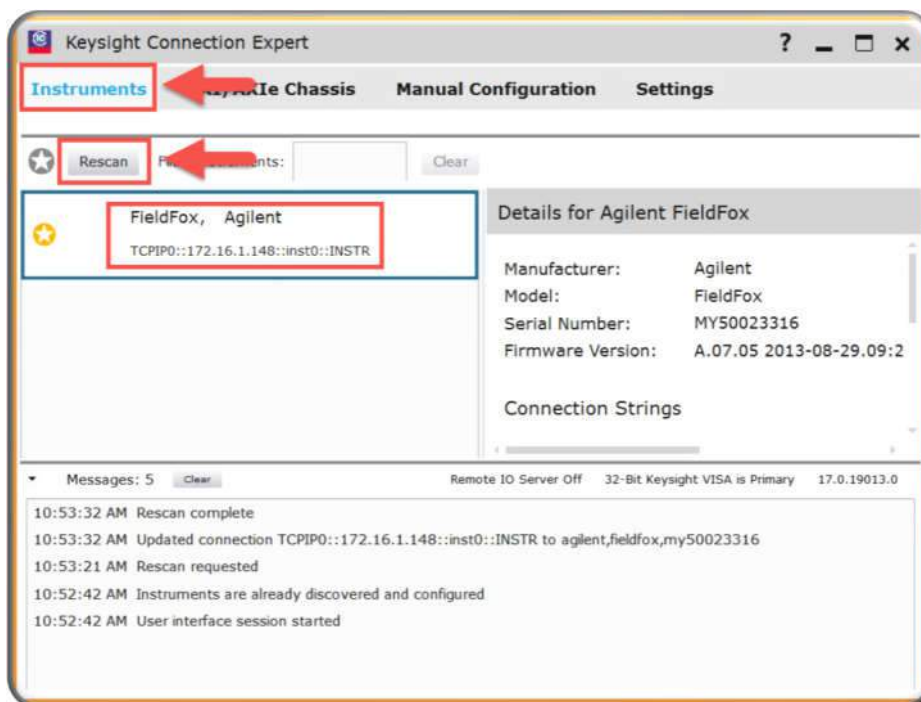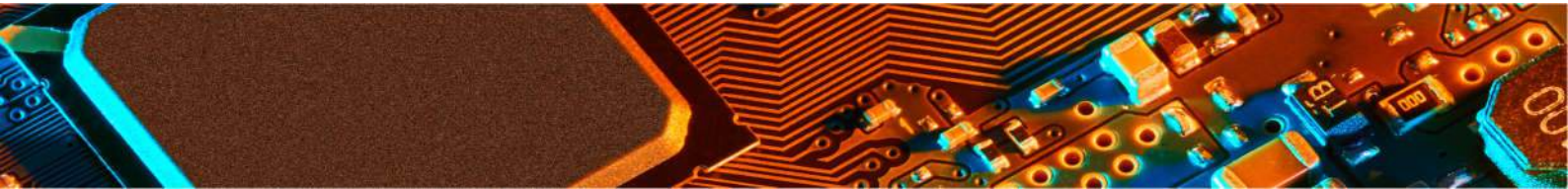• When you first connect to the spectrum analyzer open Keysight Connection Expert
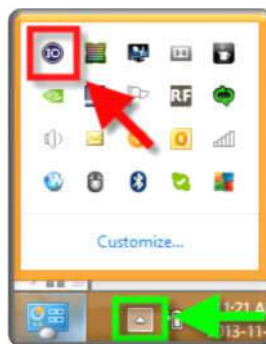
• Keysight IO will automatically detect the spectrum analyzer and display the analyzer model. If it doesn't click Rescan. If it still doesn't detect the analyzer, click Manual Configuration.
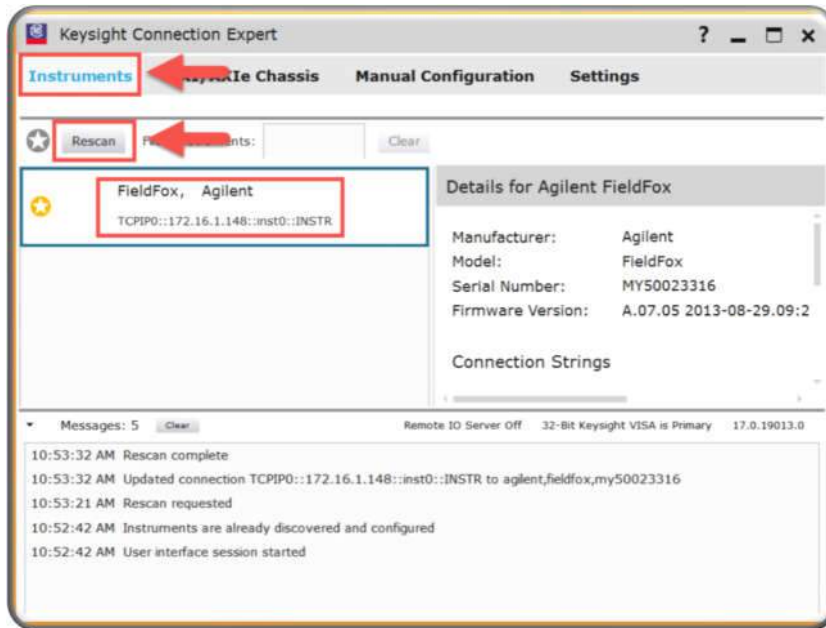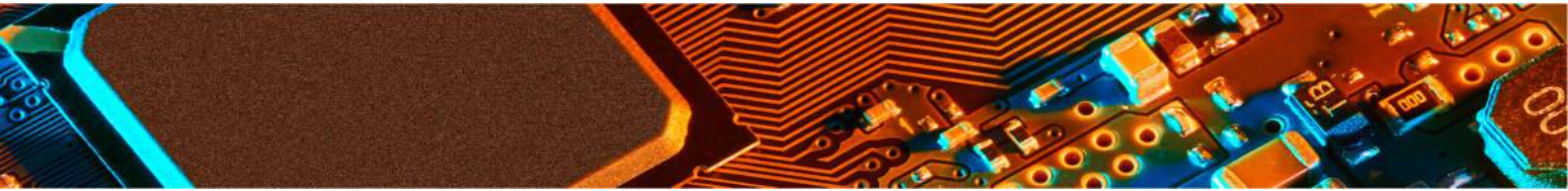
• Select LAN instrument and enter the IP address: 172.16.1.148 and click Accept.
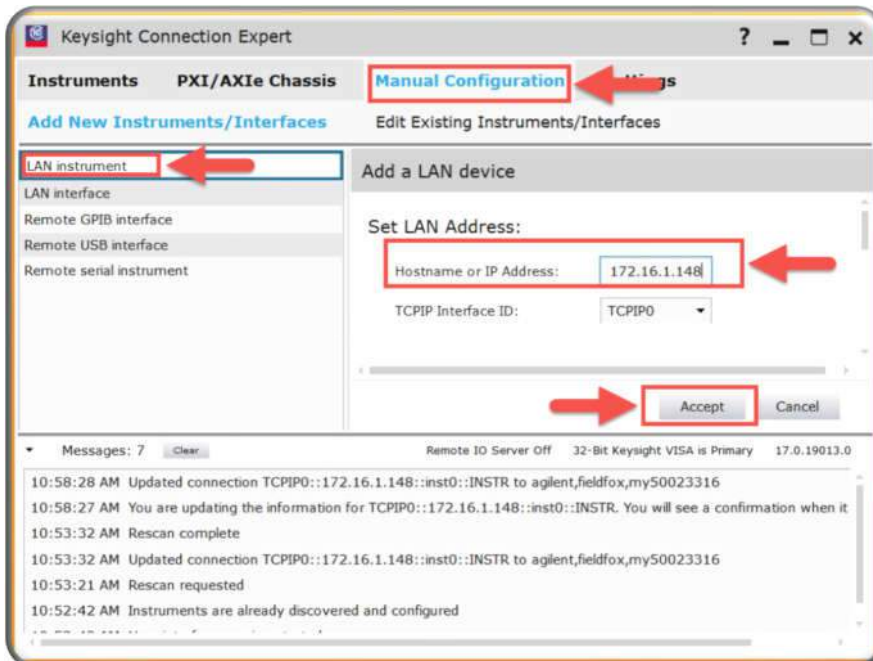
• Click Instruments tab to see that spectrum analyzer is successfully detected. It has to be a "favourite" to operate and must have a yellow star.

Keysight Connection Expert

Instruments | ...AXIe Chassis | Manual Configuration | Settings

Rescan

FieldFox, Agilent
TCPIP0::172.16.1.148::inst0::INSTR

Details for Agilent FieldFox

Manufacturer:	Agilent
Model:	FieldFox
Serial Number:	MY50023316
Firmware Version:	A.07.05 2013-08-29.09:2

Connection Strings

Messages: 5   Clear   Remote IO Server Off   32-Bit Keysight VISA is Primary   17.0.19013.0

10:53:32 AM Rescan complete
10:53:32 AM Updated connection TCPIP0::172.16.1.148::inst0::INSTR to agilent,fieldfox,my50023316
10:53:21 AM Rescan requested
10:52:42 AM Instruments are already discovered and configured
10:52:42 AM User interface session started

Step 3 – EMScanner Software

The software automatically detects the spectrum analyzer.

Turn on the spectrum analyzer, connect it to the PC and start the EMViewer software. As soon as the EMViewer software is launched, two messages are displayed at the bottom of the screen.


The EMViewer software automatically detects first the adaptor/scanner and then the analyzer. If the adaptor is not connected properly, EMViewer software gives an error message about the adaptor connection and it doesn't check the spectrum analyzer connection until the adaptor is connected to the PC properly.
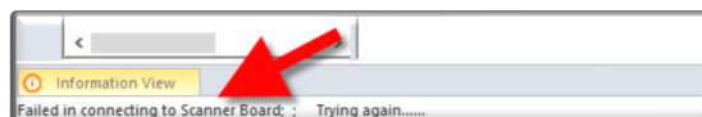
After the adaptor is connected to the PC properly, restart the EMViewer software.

If there is a connection problem between the spectrum analyzer and the PC, an error message will be displayed as shown below.
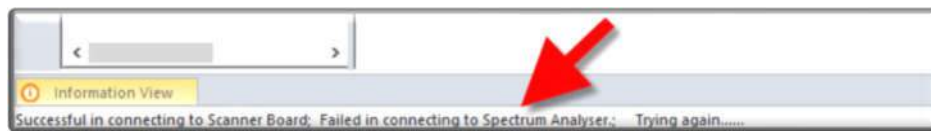
Setup and Modes of Operation

Setup

EMScanner is a very-near-field scanning system. It is composed of 1,218 H-field probes that operate between 150 kHz and 8 GHz. Probes are wideband but not very sensitive across this band thus they are very good at rejecting background noise.

EMScanner does not require a special setup like a shielded room; the Device Under Test (DUT) may sometimes however pick up strong ambient signals like those present in the cell band (850 MHz -2100 MHz) or radio FM band.

It is strongly suggested to measure the ambient noise in the test environment before running any scans with EMScanner. First power off the DUT, start the EMScanner software and then setup a Spectral Scan for the bandwidth of interest. Run the Spectral Scan and analyze the test results. If there is any ambient noise being displayed the EMScanner comparison features will allow you to filter it from the actual DUT test results.

Modes of Operation

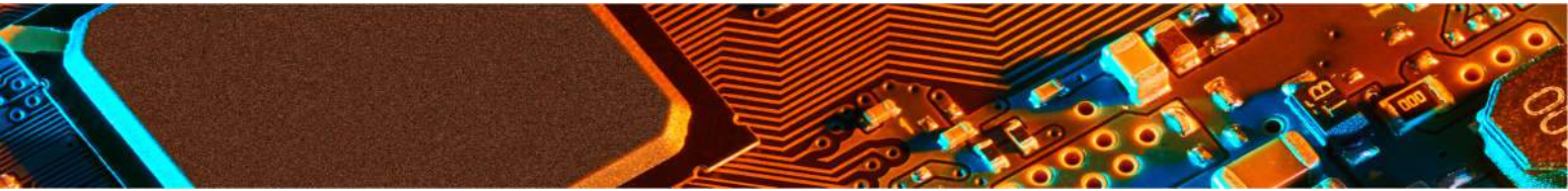**1. PCB testing (smaller than the scan area)**
Place the PCB directly anywhere on the grid of the scanner. If there are tall components that prevent the PCB from touching the surface of the scanner, use of an LNA is strongly suggested. If the other side of the PCB does not have any high components, you should scan this side.
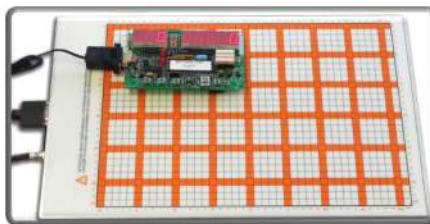
**2. PCB testing (larger than the scan area)**
You can take snapshots of the DUT by using the scanner like a hand-held probe. You can either move the scanner over the DUT or vice versa. Scan one area on the PCB and then move the scanner to the next position.
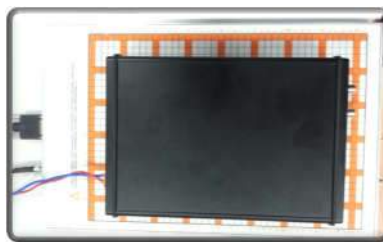

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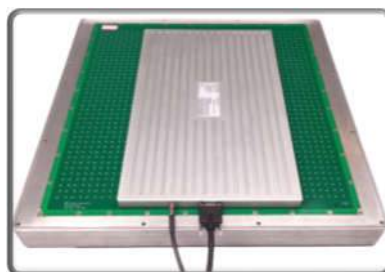
3. Cable testing

Cables from and to the PCB can be tested for emissions. Place the DUT on the scanner and tape the cables on the scanner or simply tape only the cables on the scanner.
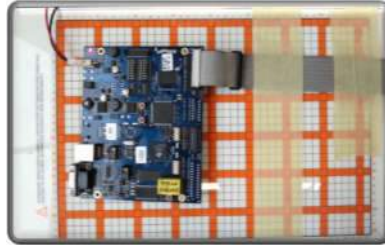
4. System testing

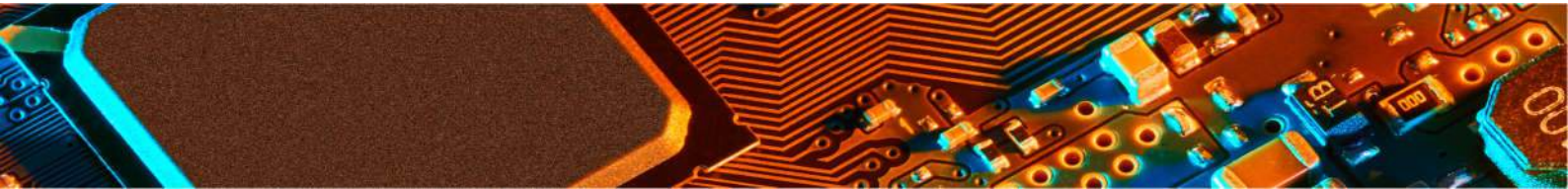EMScanner will help detect any leakages from a system under test for both frequency and location.

5. In situ testing

EMScanner is light and compact. The bottom part of EMScanner is made of anodized aluminium making it non-conductive. Care must be taken to not pierce the anodized surface since the underlying aluminium is conductive.

The Scanner can easily be placed in a rack-mount system to test the PCBs in their working environment. A mechanical arm may be required to fix the scanner for ease of testing.
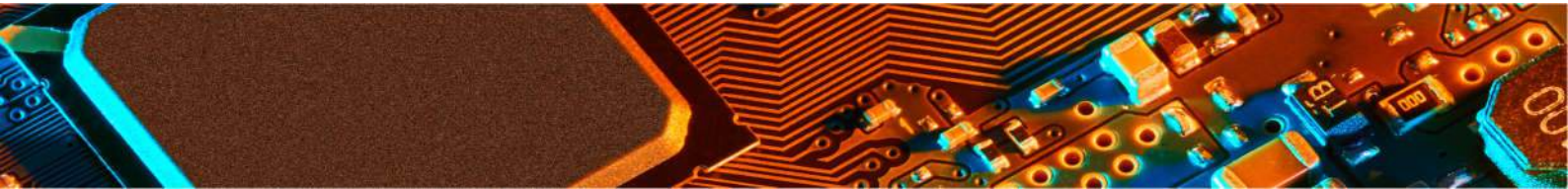
Menu Bar

Menu Bar is shown below. It allows the user to start a project node, to select a scan type, to start a single scan, to scan continuously, and to stop a scan, as well as to specify scan settings.

.
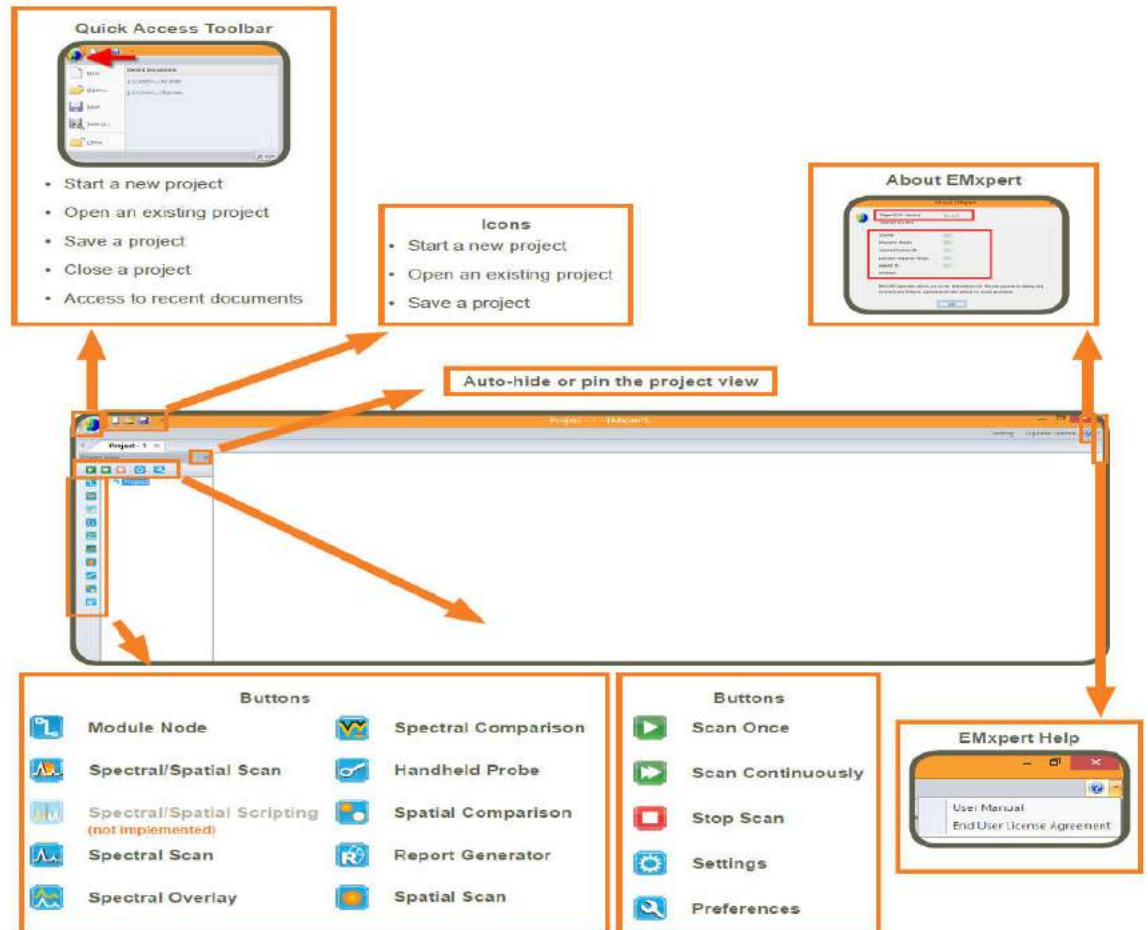
Quick Facts about Menu Bar

Multiple project files can be opened at the same time. Each file will have a dedicated tab showing the project name. Click on the tab to view the project file.
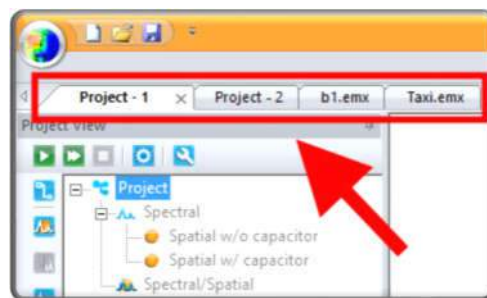
If there are any changes compared to the saved version of the project file this will be indicated by an asterisk (*) behind the file name. If you want to keep your changes, be sure to save the file before you close. In the example below, a new project file is created and then a Spectral node is added to the project file.
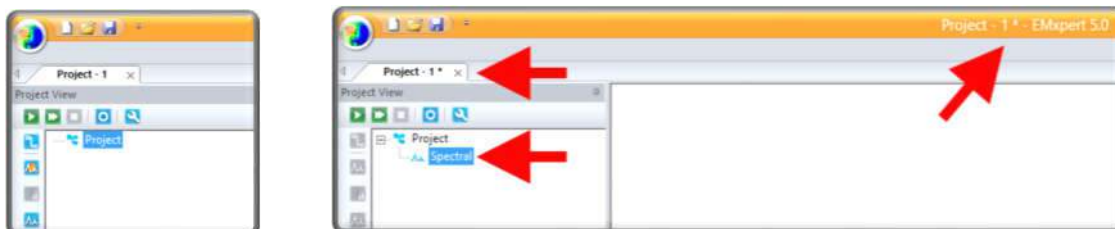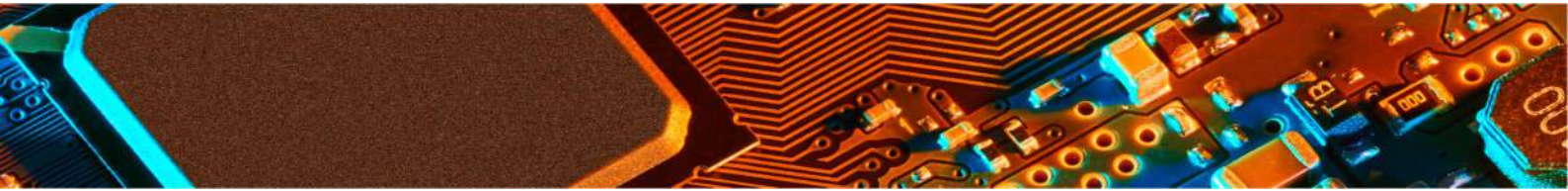

By default, Project View is pinned and displayed in the EMScanner software. In order to maximize the space to view the scan results, Project View can be hidden. Click the pin icon to auto hide Project View. Project View will be hidden and now you can

Maximize the scan window (Spectral/Spatial Scan windows automatically resizes to fit the screen). To display Project View, mouse over on Project View tab. It will be displayed if the cursor stays on Project View.
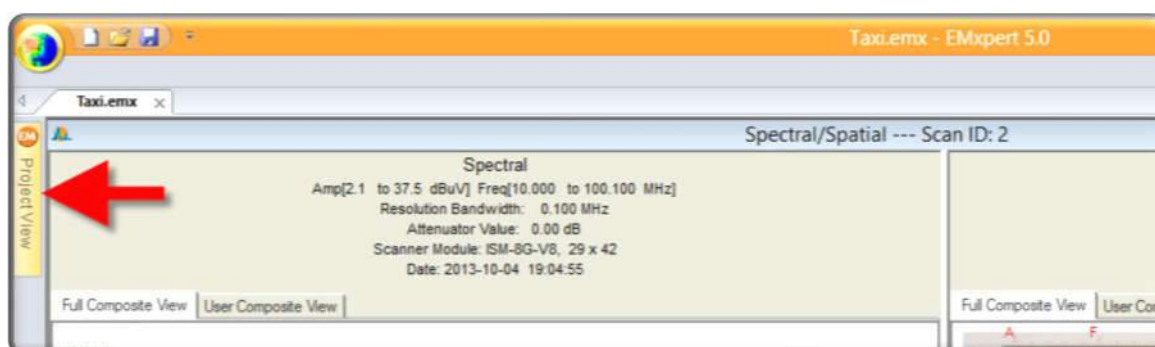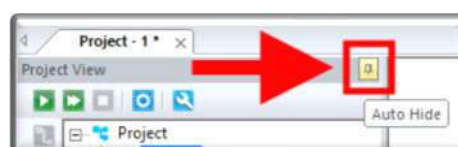
Click on Project View tab to keep the Project View visible even if you don't mouse over it. However, once you click on other part of the EMViewer software, Project View will auto hide. To pin Project View, click on the pin icon.

Viewing Scan Results

Depending on the scan type, you can view the scan results in either spectral or spatial or both views.
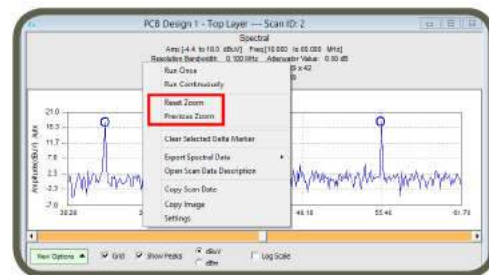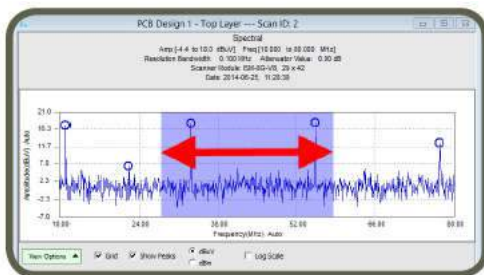
Spectral View

The name of the scan is on the top of the graph. Below the name is the scan type, scan frequencies, minimum and maximum amplitudes of this span, LNA or Attenuator values used, patented scanner model and date and time of the scan.

Mouse over the graph to display row / column coordinates, frequency and amplitude values. To select a peak, mouse over the peak and either left click the mouse or click the space bar on the keyboard.

Spectral view can be adjusted by the checkmark boxes at the bottom of the graph. Grid and Peaks can be hidden / displayed. Unit can be switched between dBuV and dBm. Linear scale is the default settings of the graph. Log Scale can be selected. Peak, Scale and Scan Options are listed under View Options.
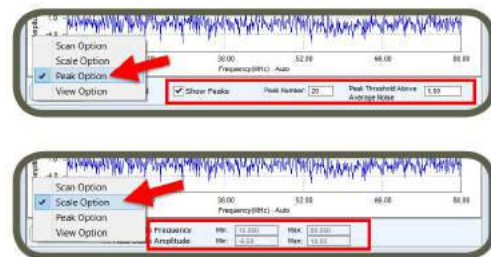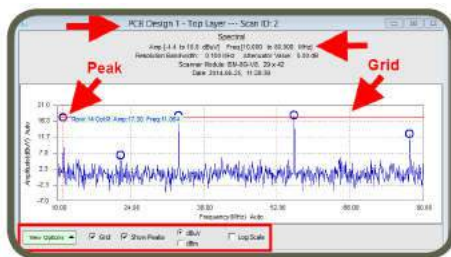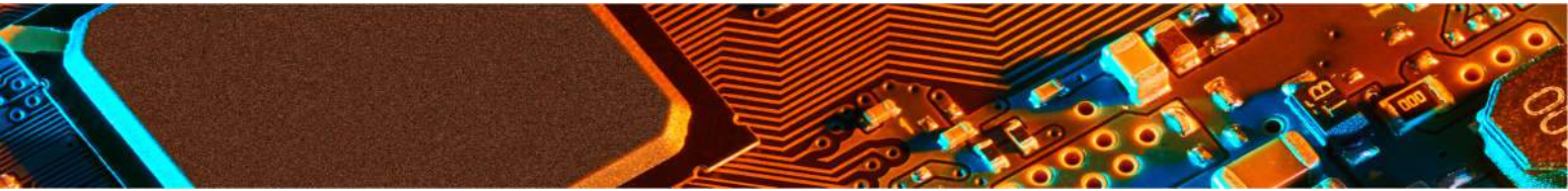

Left click and drag to zoom in. Right click and select Reset Zoom to return to the original view or Previous Zoom to return to the previous zoom level.

A Delta Marker can be set by left clicking anywhere on the spectral graph. It displays the amplitude and frequency difference between the current mouse position and the delta marker position.

Right click on the graph to display menu. You can change some settings of the Spectral Scan via Settings or Open Scan Data Description which will give information about the scan and access to Overlay Editor.
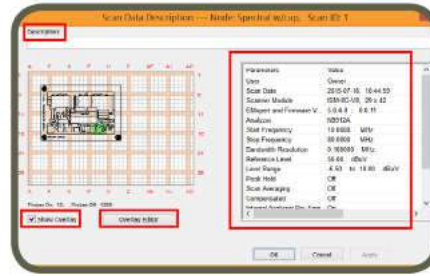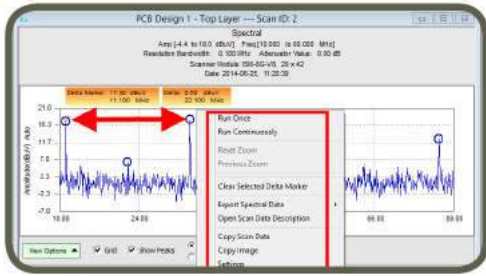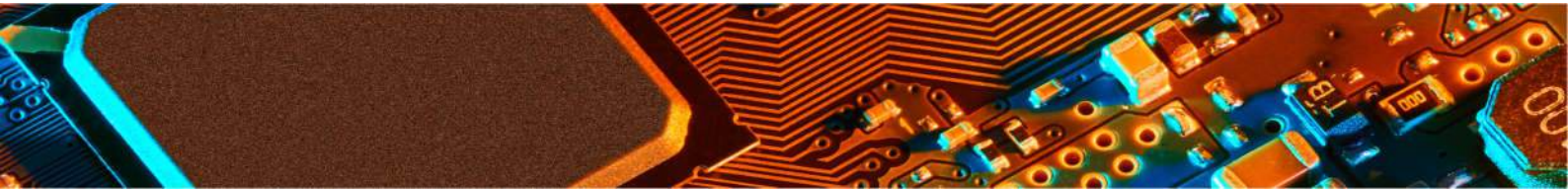
Spatial View

The name of the scan is on the top of the graph. Below name is the scan type, scan frequency, minimum and maximum amplitudes of this frequency, LNA or Attenuator values used, patented scanner model and date and time of the scan.

Mouse over the graph to display row / column coordinates, frequency and amplitude values.

Spatial view can be adjusted by the checkmark boxes at the bottom of the graph. Grid and Overlay can be hidden / displayed. Interpolation (degree of data smoothing in the image) can be turned on / off. By sliding the Set Colour Threshold on the right side of the graph, you can increase or decrease the contrast to more clearly identify current loops and peak locations. Scale and Scan Options are listed under View Options.
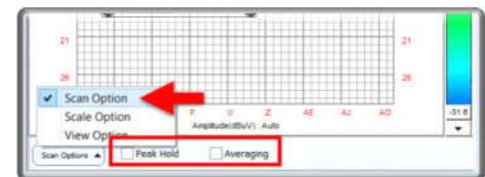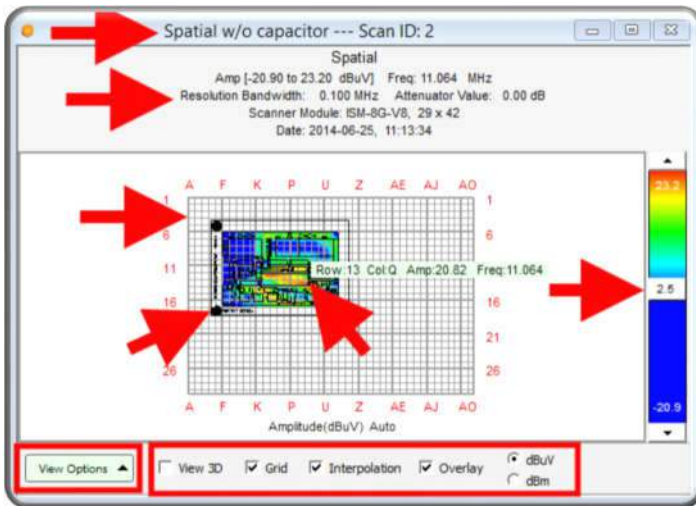
View can be changed to 3D by clicking on the check box. You can rotate the 3D view by left clicking on the graph and moving the mouse.
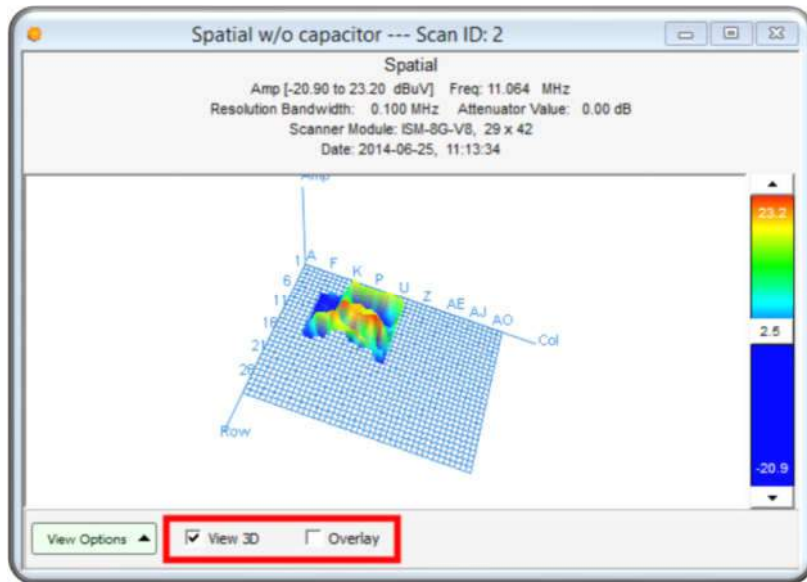
When Overlay is checked in 3D view, the wheel of the mouse will adjust the transparency. But if you press Ctrl key and then use the wheel you can move up and down the overlay to have the tip of the peaks right at the DUT level.
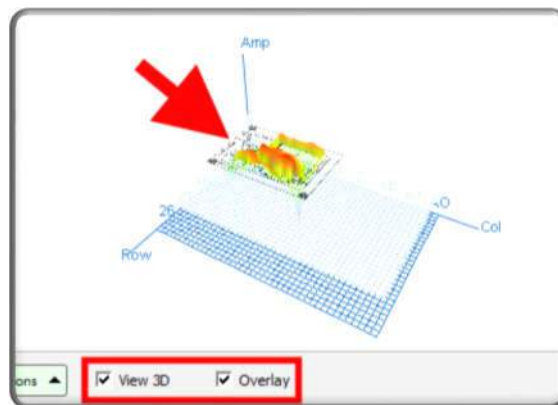
Left click and drag to zoom in.

Right click and select Reset Zoom to return to the original view or Previous Zoom to return to the previous zoom level.
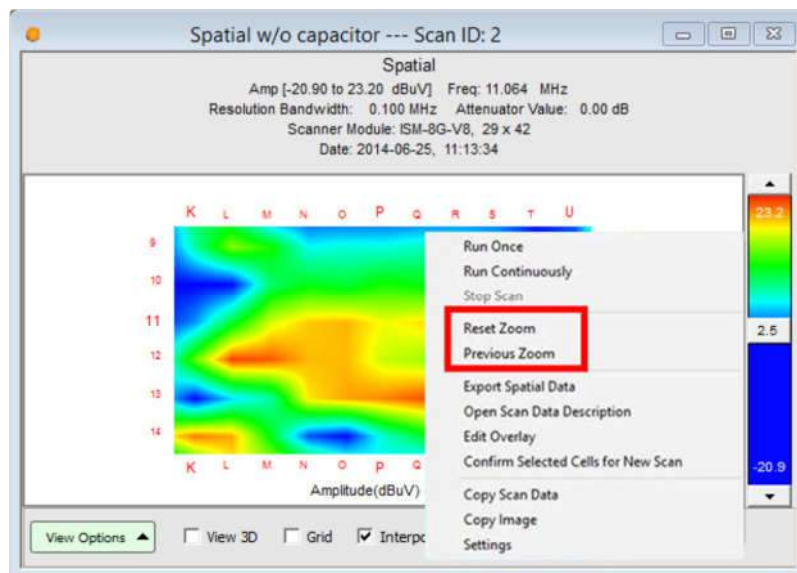
Right click on the graph to display menu.
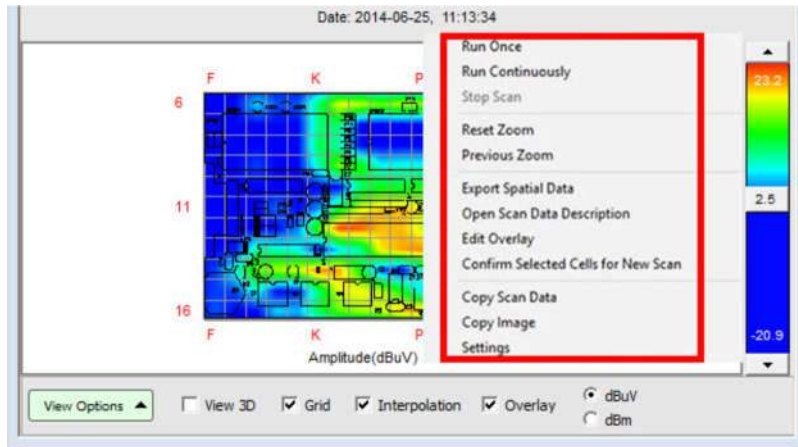
Selecting Open Scan Data Description will give information about the scan. If you select Edit Overlay you can change the Overlay post-scan to, for example, match the emissions with the Gerber of different layers instead of the usual Botto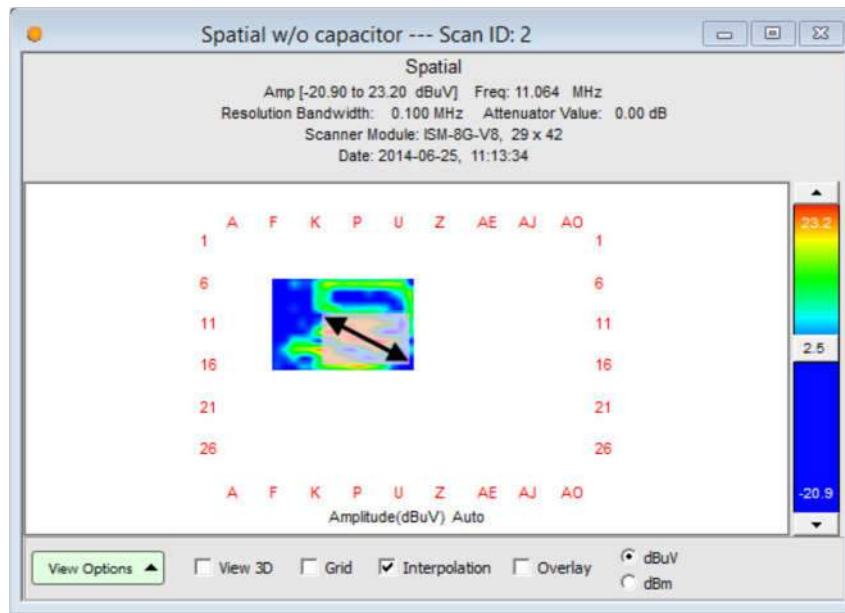m or Top layer. Or you could correct the position of the Overlay You can select a block of cells on your current spatial scan and then, by clicking on Confirm Selected Cells for New Scan, the Spatial Scan Probes settings have automatically been changed to these highlighted cells. It is easier than trying to remember the area of the board on which you want to focus for a new scan with smaller RBW for example for better sensitivity or les cells for faster scan rate.
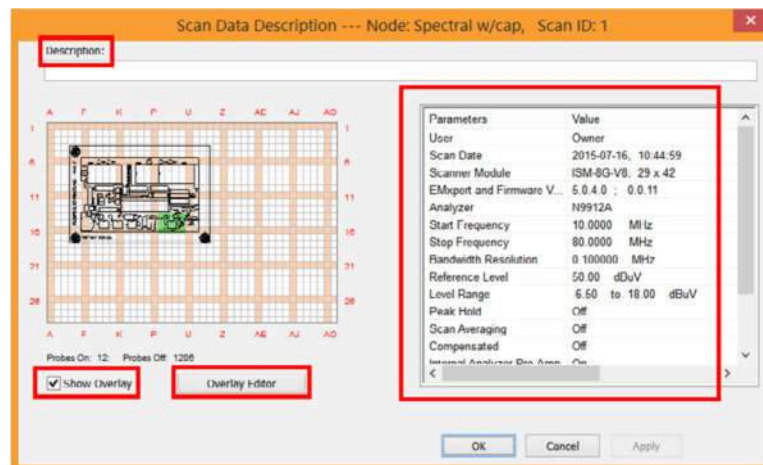
Nodes

All scan types in a project are called nodes.

A project is the root node. It can be considered a folder like in Windows directories to store related data. You can add different types of scans and/or notes to a project node. You can rename, copy and paste a node or node settings only. Project's settings are inherited throughout the entire project tree.

A module is the sub-root node. It can be considered as a subfolder like in Windows directories to store related data. You can add different types of scans and/or notes to a project

node. You can rename, copy and paste a node or node settings only. Module's settings are inherited throughout the module tree only. Modules can be used to store data for different revisions of the PCB.

Nodes that don't contain any data are light coloured.

How to Add a Node?

To add a node either right click on the Project node, click on Add Node and then select one of the scans, or click on one of the icons on the side bar to the left of the Project node.
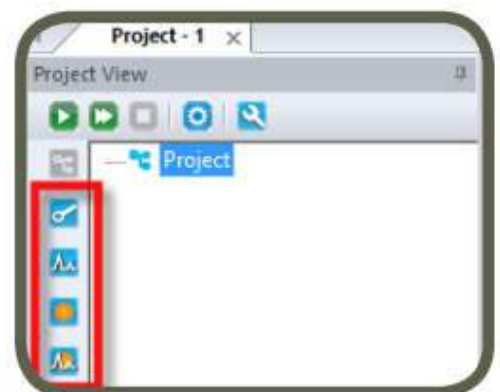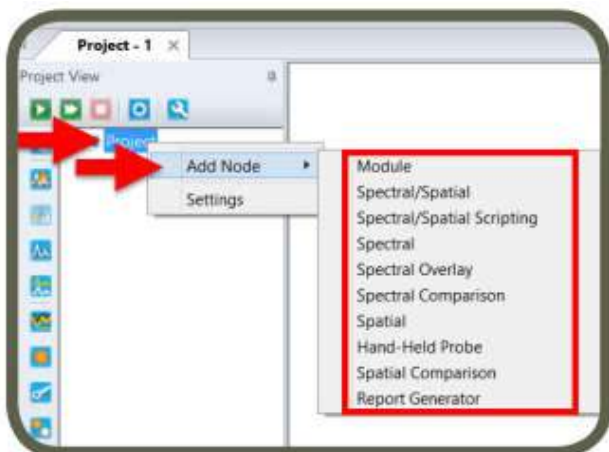
How to Name a Node?

To name a node open the Settings of the node and click on the "Description" tab. When you add a node for the first time, the Settings window opens automatically. If you want to rename a node after you add the node, either right click on the node and select Settings or select the node and then click the Settings button on the task bar.
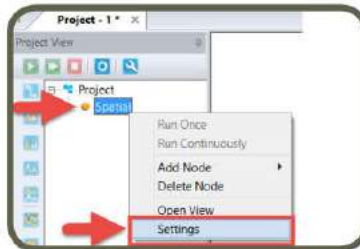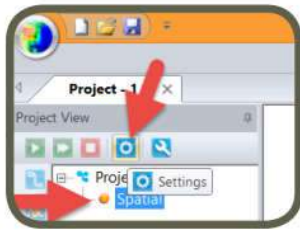
How to View a Node?

Double click on the node that you want to view or right click and select Open View
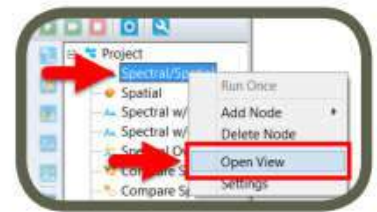
How to Delete a Node?

Double click on the node that you want to view.
Right click on the node that you want to delete and then select "Delete Node"
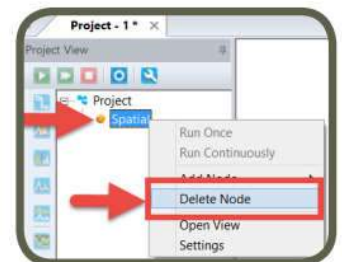
How to Export Data?

You can export any data in .txt format. To export data right click on the scan image, and select Export
Spectral Data (then select All Data or Peaks) or Export Spatial Data

Preferences: Analyzer and Display Options

Preferences present the options for the user's selection of the Spectrum Analyzer, Display Options and Probe Compensation. To access Preferences, click on. There are two tabs: Analyzer and Display Options.

Analyzer Tab

The Analyzer Tab lists models and firmware versions of the supported spectrum analyzers. Although the EMScanner software detects the spectrum analyzer automatically, you can override it by manually selecting the spectrum analyzer from the drop-down menu.
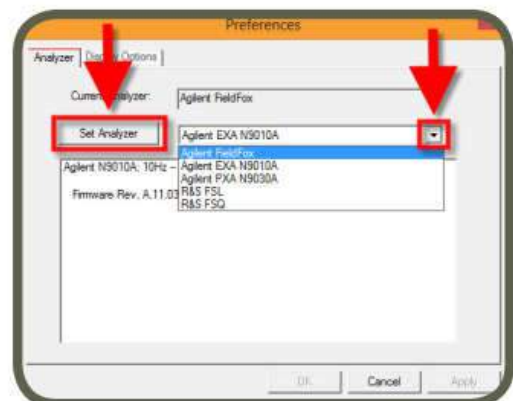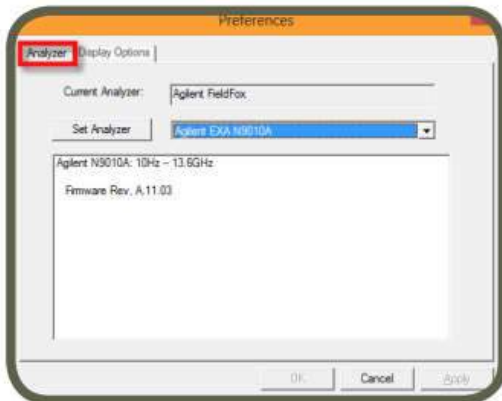
If you connect a different spectrum analyzer after the EMScanner software is launched, EMScanner software will not recognize the connection. EMScanner software must be relaunched to establish the connection between the spectrum analyzer and the PC.

Display Options Tab

Letters/Numbers: EMScanner columns are indicated by letters and all prior models' columns are indicated by numbers. Check box Display Letter for Scanner for the software to display columns with letters to match your scanner grid format.
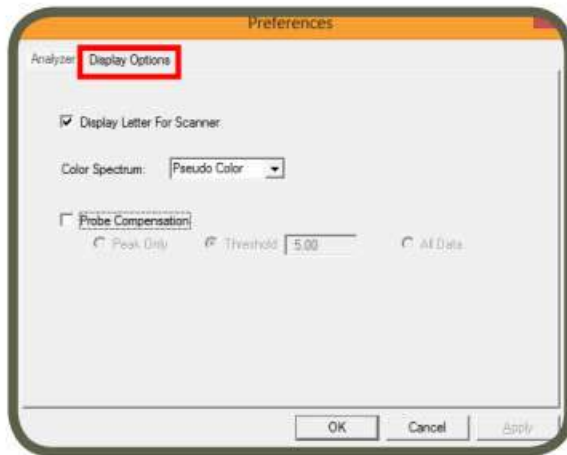
Colour Spectrum: Colour options for the spatial display.

Probe Compensation: This feature will take the calibration data for each of the 1218 probes and apply it to measured signals. You can select Peaks or All data. Compensation will normalize the individual probe response across the operating frequency and compensate for the antenna response and the air, switches and path losses. It is turned OFF by default as it only matters for far-field prediction and comparison with handheld or automated probe measurements.

Compensation can be quite high at some frequencies. If you select Peaks, noise peaks above the threshold are compensated while the noise floor is not, making any peak look like strong signals. If there is any doubt as to whether a compensated peak is in fact present, turn off the compensation altogether or select All data.

Project Node Settings

To select Project Node settings, either click on in the main control bar or right click on the Project Node and then left click on Settings. Nodes will inherit settings from project settings e.g. start/stop frequency, RBW, amplitude adjustment, overlay etc. To change settings of a scan, select the scan and click or right click on the scan and select Settings.

The tabs in the Project Settings window are covered in the following pages

Spectral Scan Tab
Enter *Start Frequency* and *Stop Frequency* to identify the span of the Spectral Scan to be implemented.

RBW (Resolution Bandwidth): It is set by default at 120 kHz and can be reduced to the lowest level allowed by the spectrum analyzer. Decreasing the bandwidth will improve the amplitude accuracy and increase the sensitivity; the scan will however take more time to complete. The bandwidth you choose should not be disproportionate to the span. The suggested ratio of Span/RBW should be <10,000 e.g. 10 kHz bandwidth with a 100 MHz span, 100 kHz bandwidth with a 1 GHz span so that the scan can finish in a reasonable time.

Reference Level: The maximum signal intensity that the spectrum analyzer can acquire at a given frequency without clipping, this setting does not need to be changed except when measuring very strong signals.

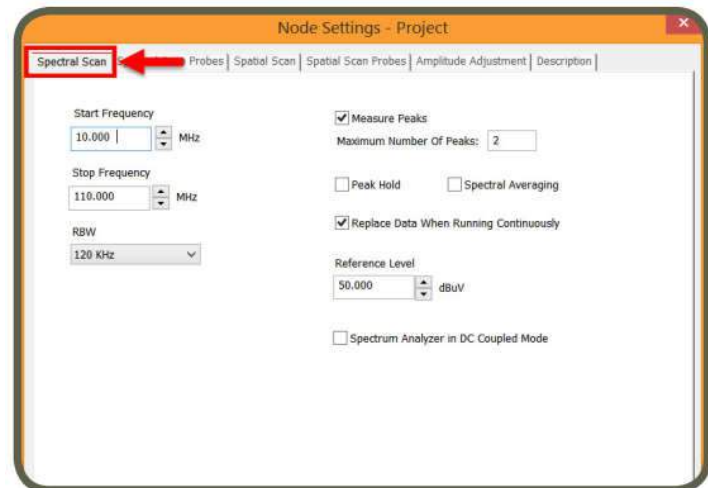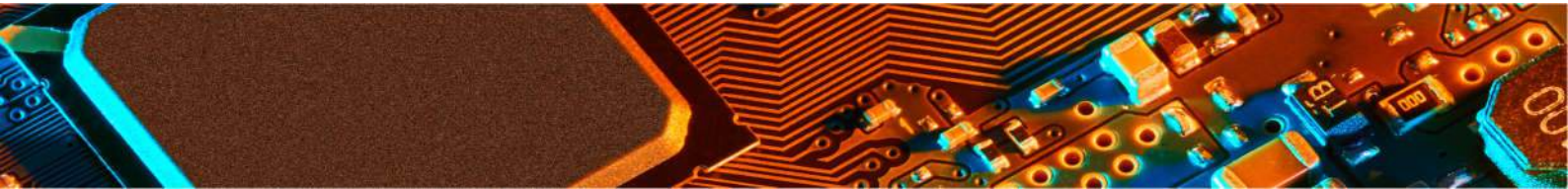*Measure Peaks:* It activates the peak marking feature whereby peaks are rescanned at a tighter bandwidth in order to accurately measure the frequency as long as the peak's value is 5 dB above the average noise floor of the scan. By default, the maximum number of peaks is set to 10. The maximum number peaks that can be measured is 30.

Peak Hold: Also known as Max-Hold this is a very important feature as it allows you to run a Spectral Scan continually replacing the peak amplitude with each successive higher measurement. This is an excellent way to find the frequency of an intermittent or random signal. *Spectral Averaging:* In the Run Continuously mode, the Spectral Scan is constantly updated with the average between the new measurement and the average of the previous measurements. It is a very important feature to help you identify the more persistent noise that could affect pre-compliance.

Replace Data When Running Continuously: If you Scan Continuously when this option is checked, EMScanner software replaces the previous scan data and keeps the last scan data. In order to keep all scan data, uncheck this option.

Spectrum Analyzer in DC Coupled Mode: When this option is checked, the analyzer goes from the protected AC mode to the unprotected DC mode. This enables a much lower noise floor in the low frequency range, usually below 10 MHz, depending on the spectrum analyzer. DC voltage applied to the spectrum analyzer input can however cause damage to the internal circuitry. The DC Coupled Mode is currently available for the Keysight EXA below 10 MHz and PSA below 20 MHz. New drivers must be developed on demand for any other spectrum analyzer. Contact Y.I.C. Technologies (support@yictechnologies.com)
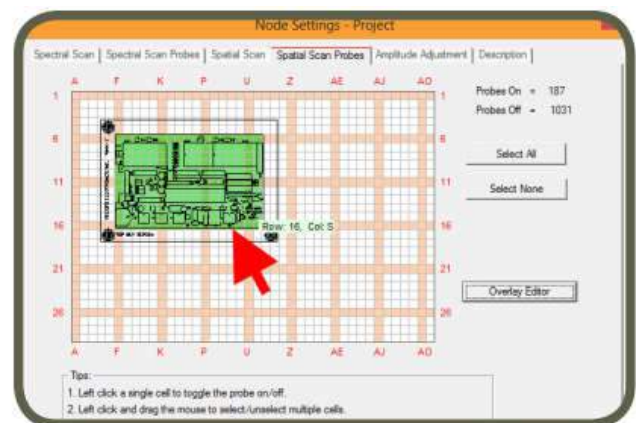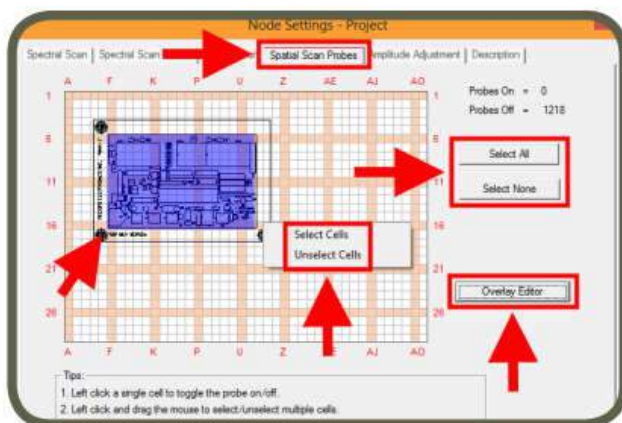
Spectral Scan Probes Tab

Select and activate the probes under the DUT. You can activate the probes by either a left click on individual cells or by left clicking and dragging the mouse and choosing Select Cells; or clicking on Select All to activate all the probes. Green indicates the activated probes.

You can deactivate the probes; either left click on already selected cells or by left clicking and dragging the mouse and choosing Unselect Cells; or by clicking on Select None to deactivate all the probes. When you mouse over the grid, row and column coordinates are displayed. Using the wheel of the mouse will adjust the transparency of the JPG file to help set the probes

Note:

Importing design file or the picture of the DUT is highly recommended. Please refer to Overlay Editor section.

By limiting the scan area, you reduce the scan time. In the case of Spectral Scan, ensure to at least have 20% to 30% of the probes selected.

Overlay Editor (How to Superimpose Graphical Image of a DUT)

Overlay Editor superimposes the graphical image of the device under test (DUT) onto Spectral Scan Probes to guide you in activating the probes. EMScanner software supports three file formats: JPG, HPGL and Gerber RS-274x. Design files (HPGL and Gerber RS-274x) are imported at actual size. Once you import the design file, you can rotate or mirror it, and/or drag it to a desired position. JPG needs to be rotated and mirrored outside the EMScanner application to match the actual DUT size and orientation; it can be resized inside the Overlay Editor.

All scan types will inherit the overlay imported in this step. To change overlay for a scan, select the scan and click or right click on the scan and select Settings.

To import an overlay file, click Overlay Editor, select design file or JPG and click open.

HPGL 2 files can not be directly imported into EMScanner software. Please contact Y.I.C. Technologies for conversion instructions
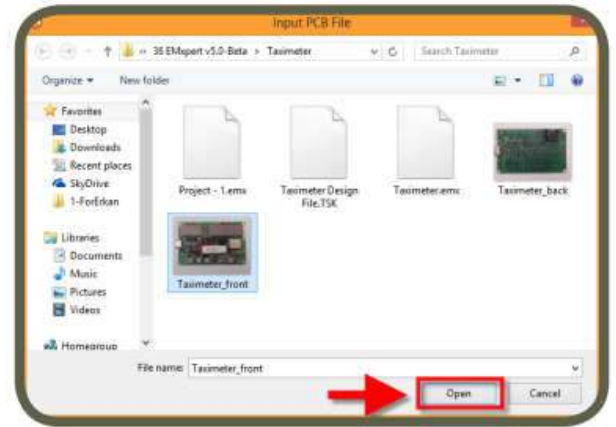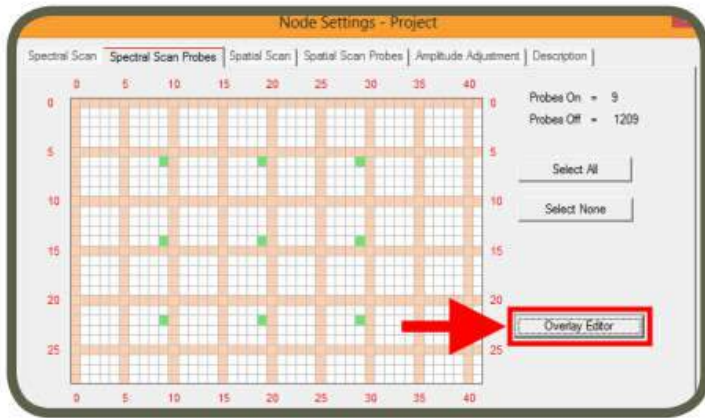
Once the file is imported, a window as shown below will open. You need to position the image to match the actual DUT position on the EMScanner. Precise positioning of Gerber or picture is done with Arrow keys. You can resize the JPG file by left clicking and dragging the bottom right corner of the image (red/green/blue coloured corner). Precise resizing of pictures is also possible with CTRL Arrow keys. To import a new PCB file or to remove the image file on the grid view, right click anywhere on the grid view and select from the menu. Using the wheel of the mouse will adjust the transparency of the JPG file to help set the probes.
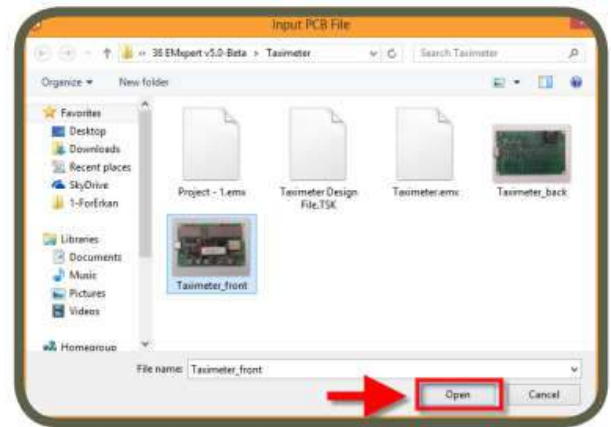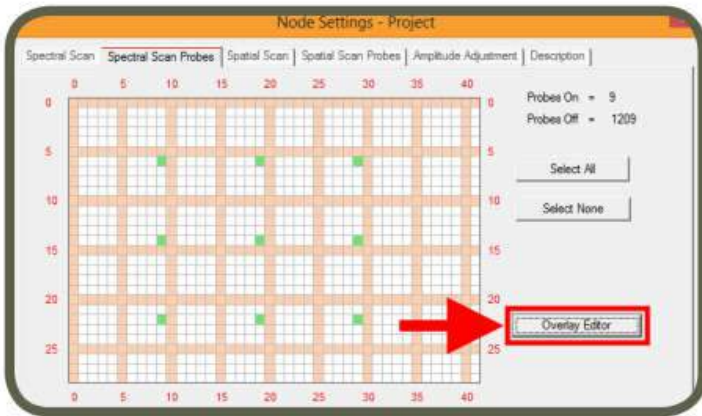
Thumbnail view of the files is listed on the left-hand column. Right click on any image to Select to view it on the grid view or to Delete it from the thumbnail view.
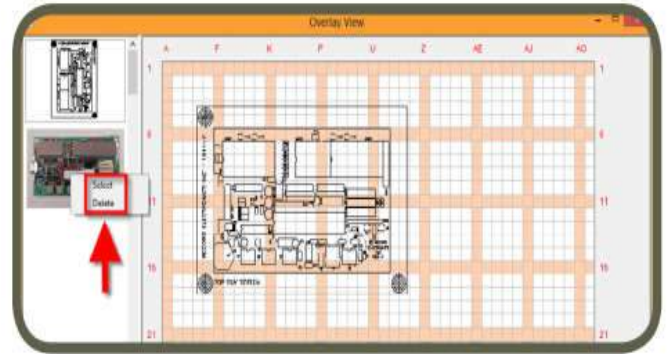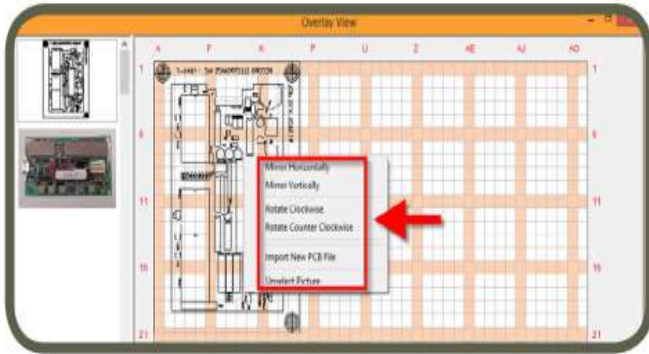
Spatial Scan Tab

Enter *Center Frequency* manually or select it from the *Peak Marker List.* The Center frequency will be set automatically to the chosen frequency *RBW (Resolution Bandwidth):* It is set by default at 120kHz and can be reduced to the lowest level allowed by the spectrum analyzer. Decreasing the bandwidth will improve the amplitude accuracy and increase the sensitivity; the scan will however take more time to complete. The bandwidth you choose should not be disproportionate to the span. The suggested ratio of Span/RBW should be <10,000 e.g. 10 kHz bandwidth with a 100 MHz span, 100 kHz bandwidth with a 1 GHz span so that the scan can finish in a reasonable time
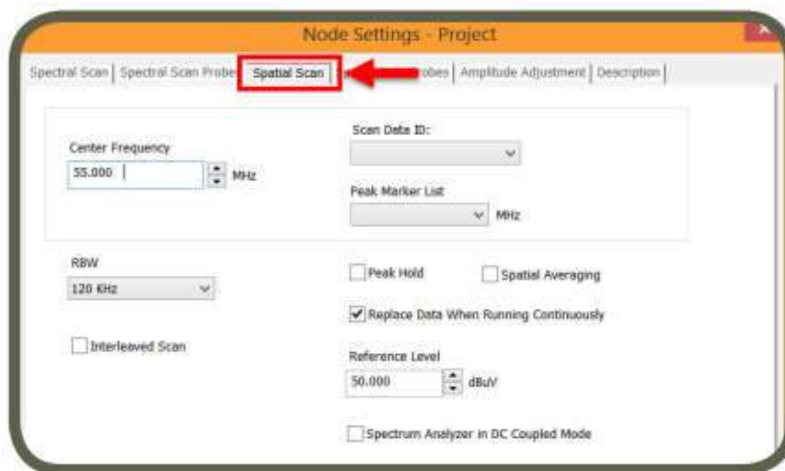
Scan Data ID: Each spectral scan is indexed automatically and by selecting the ID of a scan you get the Peak Marker List automatically populated with the marked peaks.

Interleaved Scan: This is the automated version of the Blind Spot Reduction Node. This scan is meant to overcome the limitations of the probe polarizations. By measuring a DUT twice with a small physical shift between the two scans this blind spot can be

Peak Marker List: This is the list of frequencies that were detected as being possible peaks in the parent spectral scan. If the frequency was peak marked it will show up in the list with an '—X' after it. If it was a peak that was not peak marked it will not have the ' –X' after it but it will still show up in this list.

Peak Hold: Also known as Max-Hold this is a very important feature as it allows you to run a Spatial Scan continually replacing the peak amplitude at each location with each successive higher measurement. This is an excellent way to find the location of an intermittent signal at a single frequency.

Spatial Averaging: In the Run Continuously mode, the Spatial Scan is constantly updated with the average between the new measurement and the average of the previous measurements. It is a very important feature to help you identify the more persistent noise that could affect pre-compliance.

Replace Data When Running Continuously: If you Scan Continuously when this option is checked, EMScanner software replaces the previous scan data and keeps the last scan data. In order to keep all scan data, uncheck this option.

Reference Level: The maximum signal intensity that the spectrum analyzer can acquire at a given frequency without clipping, this setting does not need to be changed except when measuring very strong signals.

Spatial Scan Probes Tab

Select and activate the probes under the DUT. You can activate the probes by either a left click on individual cells or by left clicking and dragging the mouse and choosing Select Cells; or clicking on Select All to activate all the probes. Green indicates the activated probes.

You can deactivate the probes; either left click on already selected cells or by left clicking and dragging the mouse and choosing Unselect Cells; or by clicking on Select None to deactivate all of the probes.

When you mouse over the grid, row and column coordinates are displayed. Using the wheel of the mouse will adjust the transparency of the JPG file to help set the probes.

> **Note:**
>
> Importing design file or the picture of the DUT is highly recommended. Please refer to Overlay Editor section.

It is important to activate all of the probes under the DUT to have a complete view of the emissions on the DUT.

Amplitude Adjustment Tab

You can use an LNA or attenuator with EMScanner to increase or decrease the power level of the signals coming from the scanner and going to the spectrum analyzer. To activate, click on Amplification Setting or Attenuator Setting and then select the value from the drop-down menu or type the value. The displayed value of the signal will be corrected for the value of the gain or attenuation.

Internal Analyzer Pre-Amp: This feature provides extra sensitivity. It is ON by default. Turn this feature OFF if your spectrum analyzer is not equipped with a Pre-Amp.

Analyzer Tracking Generation: This feature will remotely turn on the tracking generator of the spectrum analyzer. When you run Spectral or Spectral/Spatial Scan, the tracking generator will output a frequency that tracks the swept frequency. The Tracking Generation Feature is currently available for the Keysight FieldFox N9912A. New drivers must be developed on demand for any other spectrum analyzer; contact Y.I.C. Technologies (support@yictechnologies.com)

Description Tab

You can name the node and add a description.

Report Generator

The Report Generator Node allows the user to generate standard scan reports by exporting the scans into Microsoft Office Word for Windows report template.
Report generator needs Microsoft Office Word.
To create a report, add Report Generator node to any node. Node settings window automatically opens. Click on the box next to Project to be able to subsequently select any of the node data to export by clicking on each node and scan ID. Or simply click on the one scan you wish by first checking the box on the node and then selecting the Scan ID you wish to see in the report.

www.yictechnologies.com
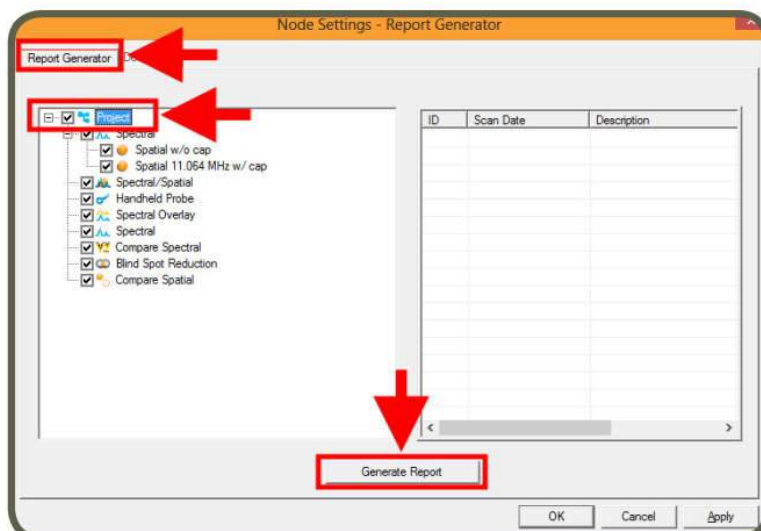
You can select any scan and any data of that scan to generate the report.
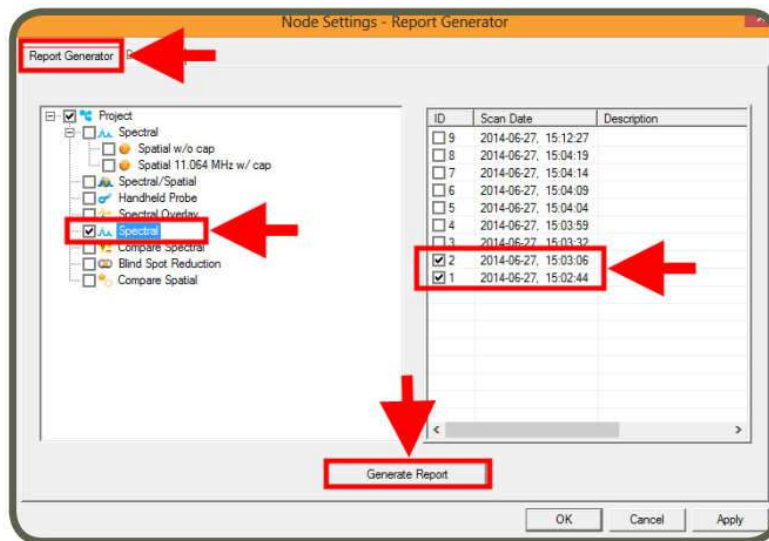
Scan Types

There are four scan types:

• **Spectral Scan:** measures and displays the maximum amplitude vs. frequency of the magnetic field strength over the scanned area.

• **Spatial Scan:** measures the magnetic field of radiated electromagnetic emissions from the DUT at a single frequency as a function of position. It can be a single scan or interleaved scan. *Interleaved Scan* is meant to overcome the limitations of the probe polarizations. By measuring a DUT twice with a small physical shift between the two scans this blind spot can be eliminated.

• **Spectral / Spatial Scan:** measures the magnetic field strength of radiated electromagnetic emissions from an object as a function of both frequency and position on the PCB. It collects a series of Spatial Scans over the entire frequency range of interest as opposed to a Spatial Scan (which gathers data at single frequency) or a Spectral Scan (which saves only the composite maximum data set over the scan area).

• **Spectral Overlay:** is a qualitative comparison of two frequency spectra. It superimposes one frequency spectrum over another.

• **Compare Spectral:** is a quantitative comparison between two frequency spectra. It is generated by subtracting the values of one spectrum from the values of the second spectrum at each frequency.

• **Spatial Blind Spot Reduction:** is now available as the Interleaved function in Spatial Scan. Spatial Blind Spot Reduction is kept to analyze in the future the data from projects prior to 5.0.

• **Compare Spatial:** is a quantitative comparison between two Spatial Scans that is generated by subtracting the values of the first scan from the values of the second scan cell by cell.

To run a scan:

1. Place the PCB or other device under test (DUT) on the patented scanner
2. Select the scan type on EMScanner software
3. Run the scan

Power up the PCB or DUT and place it on the scanner aligning as closely as possible to the vertical and horizontal guidelines. Lining up with the squares assists you when importing overlays
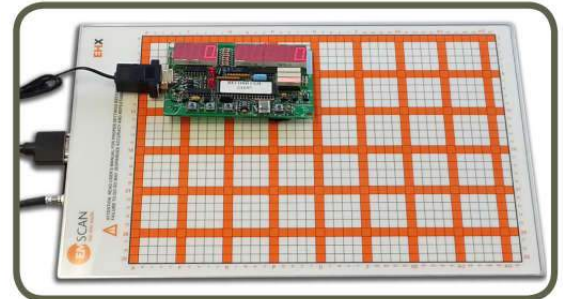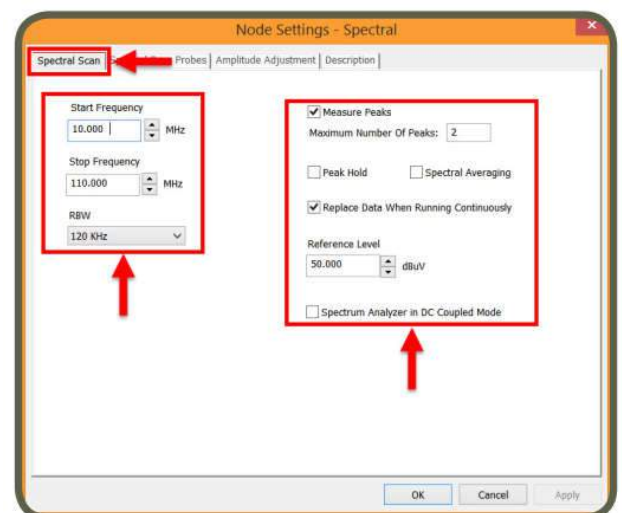

Placing PCB on EMScanner

Spectral Scan

Spectral Scan measures and displays the maximum amplitude vs. frequency of the magnetic field strength over the scanned area.
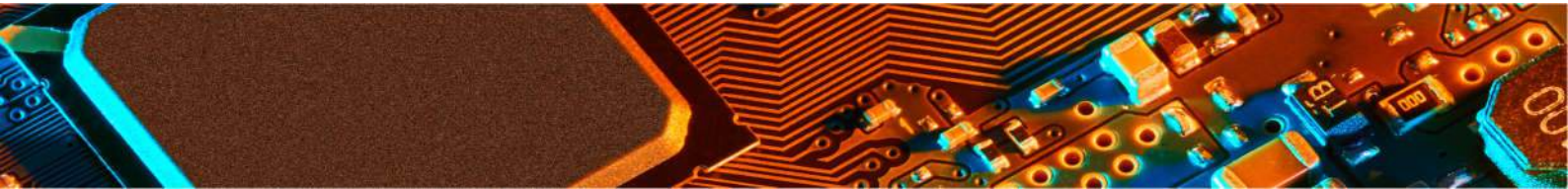Add Spectral Scan node to Project node. Node settings window automatically opens.
Spectral Scan inherits the setting parameters that were selected in the settings of the Project node. You can override any of the inherited setting parameters by modifying the tabs in the Spectral Scan settings window. The tabs in the Spectral Scan Settings window are covered in the following pages.

Spectral Scan Tab
1. Enter *Start Frequency* and *Stop Frequency* to identify the span of the Spectral Scan to be implemented.
2. RBW (Resolution Bandwidth): It is set by default at 120 kHz and can be reduced to the lowest level allowed by the spectrum analyzer. Decreasing the bandwidth will improve the amplitude accuracy and increase the sensitivity; the scan will however take more time to complete. The bandwidth you choose should not be disproportionate to the span. The suggested ratio of Span/RBW should be <10,000 e.g. 10 kHz bandwidth with a 100 MHz span, 100 kHz bandwidth with a 1 GHz span so that the scan can finish in a reasonable time.

3. Reference Level: The maximum signal intensity that the spectrum analyzer can acquire at a given frequency without clipping, this setting does not need to be changed except when measuring very strong signals.
4. Measure Peaks: It activates the Peak marking feature whereby peaks are rescanned at a tighter bandwidth in order to accurately measure the frequency if the peak's value is

5 dB above the average noise floor of the scan. By default, the maximum number of peaks is set to 10. The maximum number peaks that can be measured is 30.

5. Peak Hold: Also known as Max-Hold this is a very important feature as it allows you to run a Spectral Scan continually replacing the peak amplitude with each successive higher measurement. This is an excellent way to find the frequency of an intermittent or random signal.

6. *Spectral Averaging:* In the Run Continuously mode, the Spectral Scan is constantly updated with the average between the new measurement and the average of the previous measurements. It is a very important feature to help you identify the more persistent noise that could affect pre-compliance.

7. Replace Data When Running Continuously: If you Scan Continuously when this option is checked, EMScanner software replaces the previous scan data and keeps the last scan data. In order to keep all scan data, uncheck this option.

8. Spectrum Analyzer in DC Coupled Mode: When this option is checked, the analyzer goes from the protected AC mode to the unprotected DC mode. This enables a much lower noise floor in the low frequency range, usually below 10 MHz, depending on the spectrum analyzer. DC voltage applied to the spectrum analyzer input can however cause damage to the internal circuitry. The DC Coupled Mode is currently available for the Keysight EXA below 10 MHz and PSA below 20 MHz. New drivers must be developed on demand for any other spectrum analyzer. Contact Y.I.C. Technologies (support@yictechnologies.com)

9. Click Apply

Spectral Scan Probes Tab
Select and activate the probes under the DUT. You can activate the probes by either a left click on individual cells or by left clicking and dragging the mouse and choosing Select Cells; or clicking on Select All to activate all of the probes. Green indicates the activated probes.
You can deactivate the probes; either left click on already selected cells or by left clicking and dragging the mouse and choosing Unselect Cells; or by clicking on Select None to deactivate all of the probes.
When you mouse over the grid, row and column coordinates are displayed.
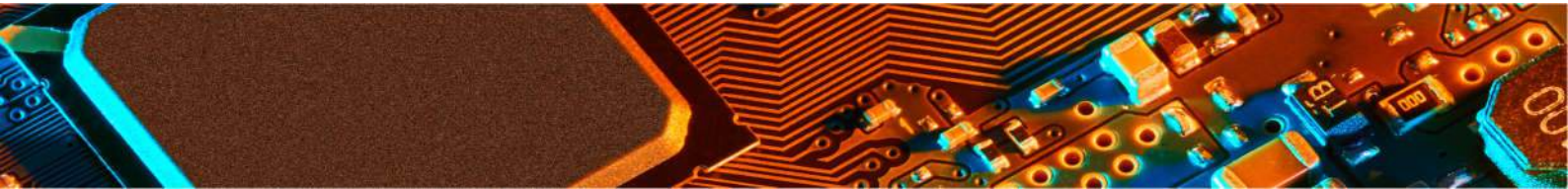Using the wheel of the mouse will adjust the transparency of the JPG file to help set the probes.

> **Note:**
> Importing design file or the picture of the DUT is highly recommended. Please refer to Overlay Editor section.
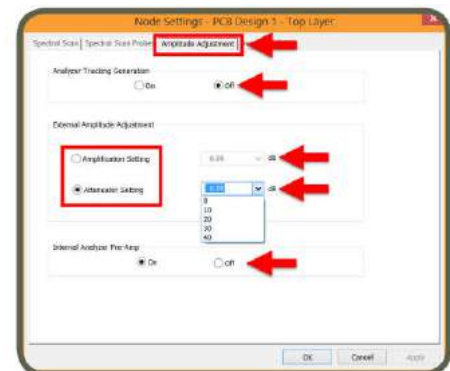
By limiting the scan area, you reduce the scan time. In the case of Spectral Scans, ensure to at least have 20% to 30% of the probes selected.

Amplitude Adjustment Tab

You can use an LNA or attenuator with EMScanner to increase or decrease the power level of the signals coming from the scanner and going to the spectrum analyzer. To activate click on Amplification Setting or Attenuator Setting and then select the value from the drop down menu or type the value. The displayed value of the signal will be corrected for the value of the gain or attenuation.

Internal Analyzer Pre-Amp: This feature provides extra sensitivity. It is ON by default. Turn this feature OFF if your spectrum analyzer is not equipped with a Pre-Amp.

Analyzer Tracking Generation: This feature will remotely turn on the tracking generator of the spectrum analyzer. When you run Spectral or Spectral/Spatial Scan, the tracking generator will output a frequency that tracks the swept frequency. The Tracking Generation Feature is currently available for the Keysight FieldFox N9912A.

Description Tab

You can name the node and add a description. Click OK. To run the scan once click or to run the scan continuously click. The progress bar on the lower right of the screen will indicate the progress of the scan. The system will take a few more seconds for marking peaks (EMScanner rescans at a smaller span around the entire major peaks to more accurately identify the peaks and mark them with a blue circle. This is done to overcome the 1% to 2% of span spectrum analyzer error and to verify the existence of the peaks).
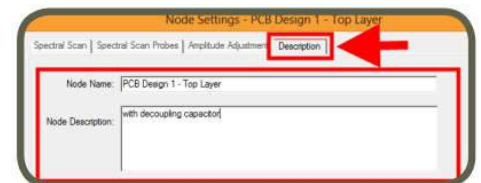
Once the scan is completed, an image of the scan will be displayed. You can mouse over the graph to
see coordinates, frequency and amplitude data.
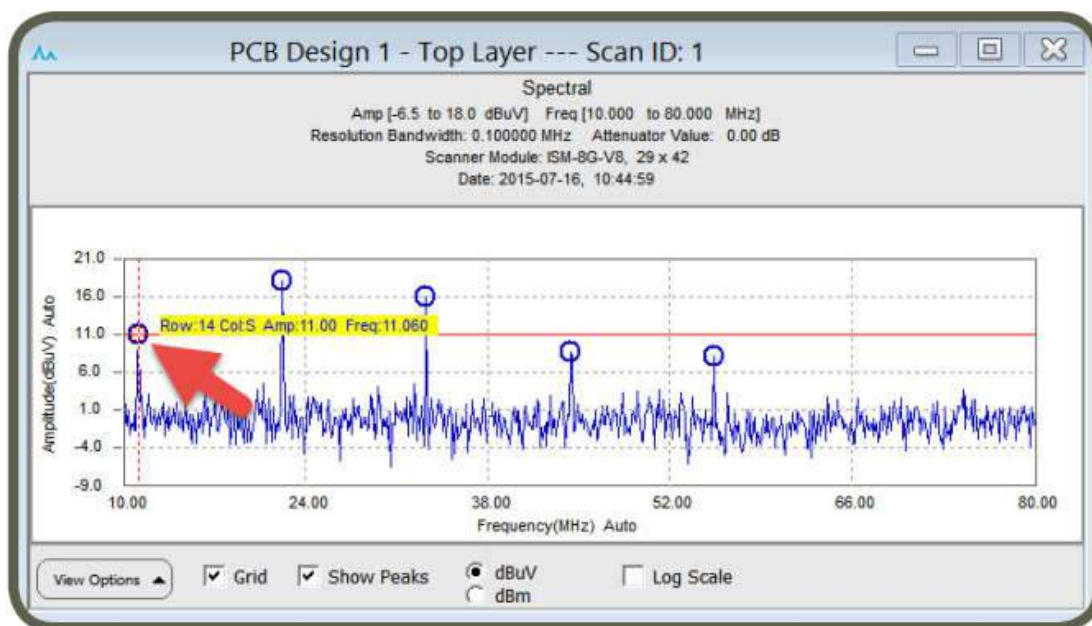
When running the scan continuously, if *Replace Data When Running Continuously* in the Spectral Scan settings is selected, the EMScanner software replaces the previous scan data and keeps the last scan data. You will only see the last scan data and display the spectral graph of this data.

en running the scan continuously, uncheck *Replace Data* ne Spectral Scan settings. You can display spectral ly click on the scan and the graph will immediately update.
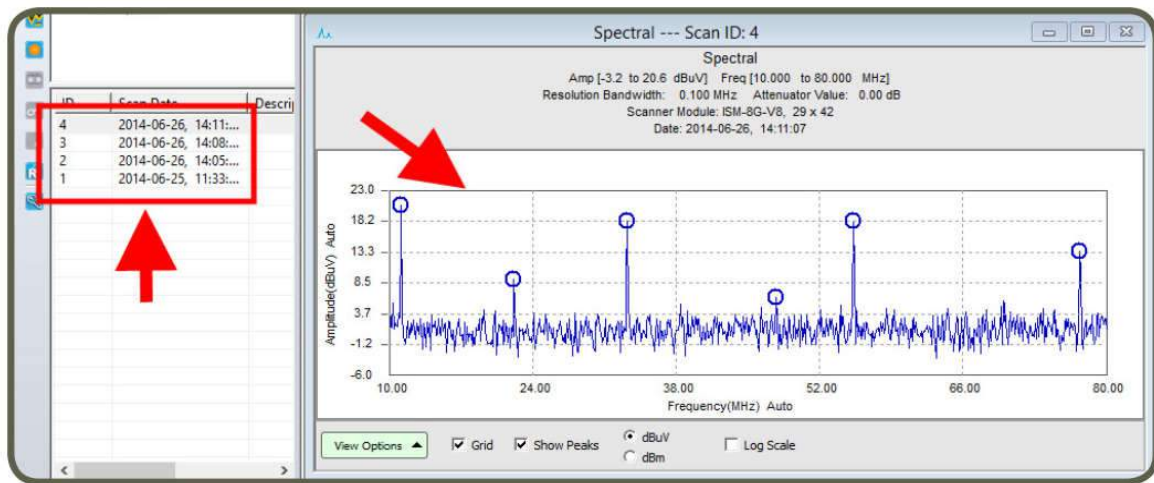
Spectral Scan/Spatial Scan

A Spectral/Spatial Scan measures the magnetic field strength of radiated electromagnetic emissions from an object as a function of both frequency and position on the PCB.
The Spectral/Spatial Scan collects a series of Spatial Scans over the entire frequency range of interest as opposed to a Spatial Scan (which gathers data at single frequency) or a Spectral Scan (which saves only the composite maximum data set over the scan area).
Using the viewers included in Spectral/Spatial nodes, you can:
• view spectral data on a cell or group of cells
• view spatial data at a single frequency or several different frequencies
• link together data from the two views i.e., any cell or collection of cells in a spatial view can be selected and the composite spectral can be displayed
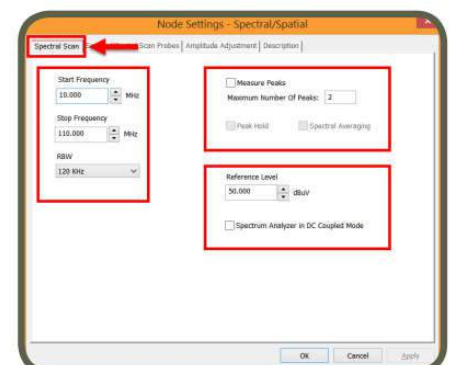Previously we used a Spectral Scan to detect the frequencies of interest then individual Spatial Scans to gather data about each frequency of interest. In a sweep that takes no longer than a Spectral Scan, a Spectral/Spatial Scan collects all of the frequency, amplitude and location data at the same time. This results in a large data base of information that can be manipulated. It however can only run once; it is not possible to run continuously.
Add Spectral/Spatial Scan node to Project node. Node settings window automatically opens. Spectral/Spatial Scan inherits the setting parameters that were selected in the settings of the Project node. You can override any of the inherited setting parameters by modifying the tabs in the Spectral/Spatial Scan settings window.

The tabs in the Spectral/Spatial Scan Settings window is covered in the following pages.

Spectral Scan Tab
1. Enter *Start Frequency* and *Stop Frequency* to identify the span of the Spectral Scan to be implemented.
2. RBW (Resolution Bandwidth): It is set by default at 120 kHz and can be reduced to the lowest level allowed by the spectrum analyzer.

Decreasing the bandwidth will improve the amplitude accuracy and increase the sensitivity; the scan will however take more time to complete.

The bandwidth you choose should not be disproportionate to the span. The suggested ratio of Span/RBW should be <10,000 e.g. 10 kHz bandwidth with a 100 MHz span, 100 kHz bandwidth with a 1 GHz span so that the scan can finish in a reasonable time.

3.Reference Level: The maximum signal intensity that the spectrum analyzer can acquire at a given frequency without clipping, this setting does not need to be changed except when measuring very strong signals.

4. Measure Peaks: It activates the peak marking feature whereby peaks are rescanned at a tighter bandwidth in order to accurately measure the frequency as long as the peak's value is 5 dB above the average noise floor of the scan. By default, the maximum number of peaks is set to 10. The maximum number peaks that can be measured is 30. There is little value in activating this function in the Spectral/Spatial node.

5. Peak Hold: This feature is not active for Spectral/Spatial Scan.

6. Spectral Averaging: This feature is not active for Spectral/Spatial Scan.

7. Spectrum Analyzer in DC Coupled Mode: When this option is checked, the analyzer goes from the protected AC mode to the unprotected DC mode. This enables a much lower noise floor in the low frequency range, usually below 10 MHz, depending on the spectrum analyzer. DC voltage applied to the spectrum analyzer input can however cause damage to the internal circuitry. The DC Coupled Mode is currently available for the Keysight EXA below 10 MHz and PSA below 20 MHz. New drivers must be developed on demand for any other spectrum analyzer. Contact Y.I.C or your local account manager.
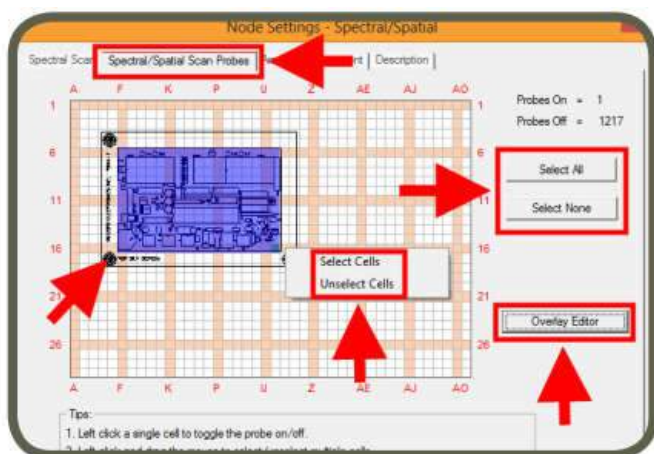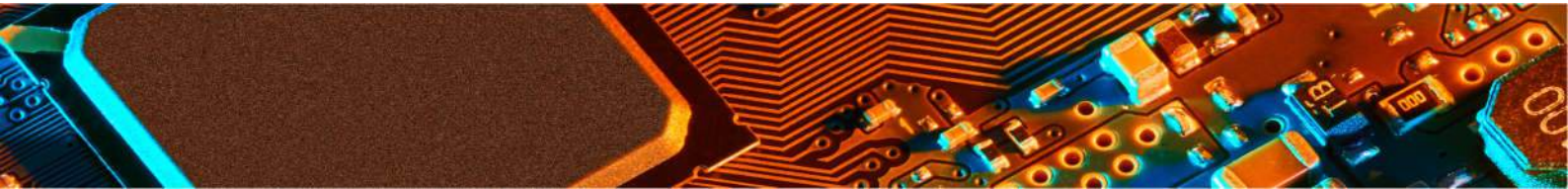
8. Click Apply

Spectral/Spatial Scan Probes Tab

Select and activate the probes under the DUT. You can activate the probes by either a left click on individual cells or by left clicking and dragging the mouse and choosing Select Cells; or clicking on Select All to activate all of the probes. Green indicates the activated probes.

You can deactivate the probes; either left click on already selected cells or by left clicking and dragging the mouse and choosing Unselect Cells; or by clicking on Select None to deactivate all of the probes.

When you mouse over the grid, row and column coordinates are displayed.

Using the wheel of the mouse will adjust the transparency of the JPG file to help set the probes.

It is important to activate all the probes under the DUT to have a complete view of the emissions from the DUT.

Amplitude Adjustment Tab
You can use an LNA or attenuator with EMScanner to increase or decrease the power level of the signals coming from the scanner and going to the spectrum analyzer. To activate click on Amplification Setting or Attenuator Setting and then select the value from the drop down menu or type the value. The displayed value of the signal will be corrected for the value of the gain or attenuation.
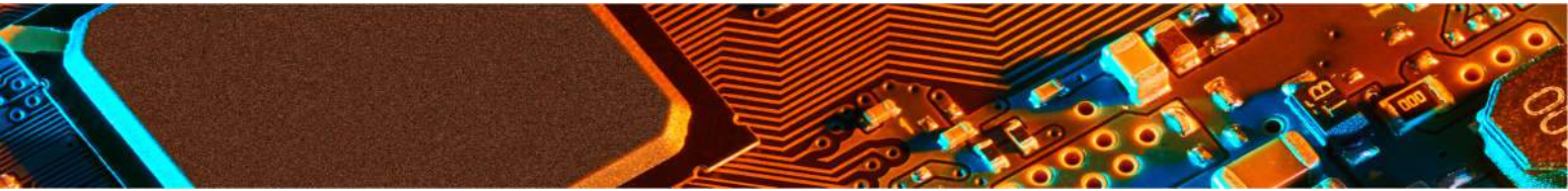
Internal Analyzer Pre-Amp: This feature provides extra sensitivity. It is ON by default. Turn this feature OFF if your spectrum analyzer is not equipped with a Pre-Amp.

Analyzer Tracking Generation: This feature will remotely turn on the tracking generator of the spectrum analyzer. When you run Spatial Scan, the tracking generator will output at the centre frequency selected for the Spatial Scan. The Tracking Generation Feature is currently available for the Keysight FieldFox N9912A. New drivers must be developed on demand for any other spectrum analyzer; contact Y.I.C Technologies (support@yictechnologies.com)
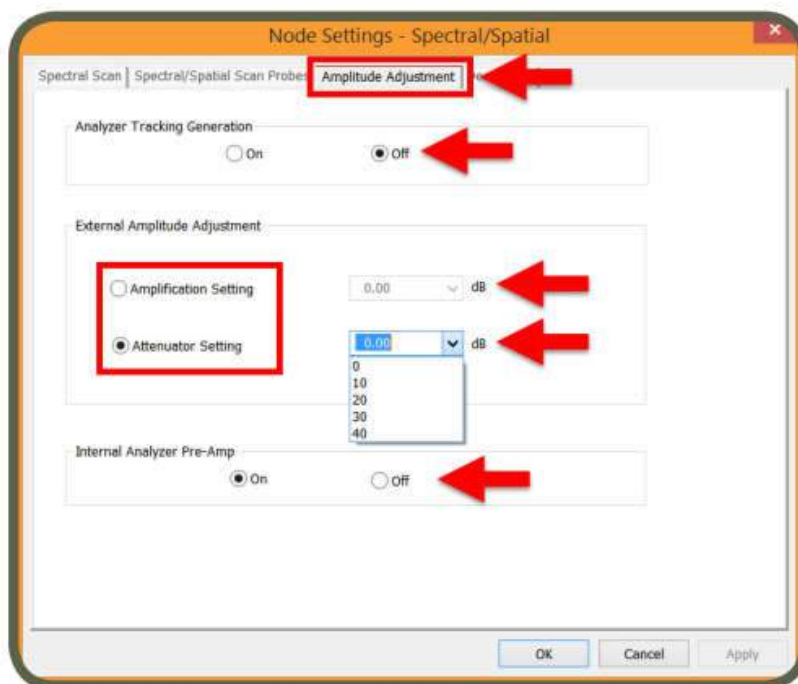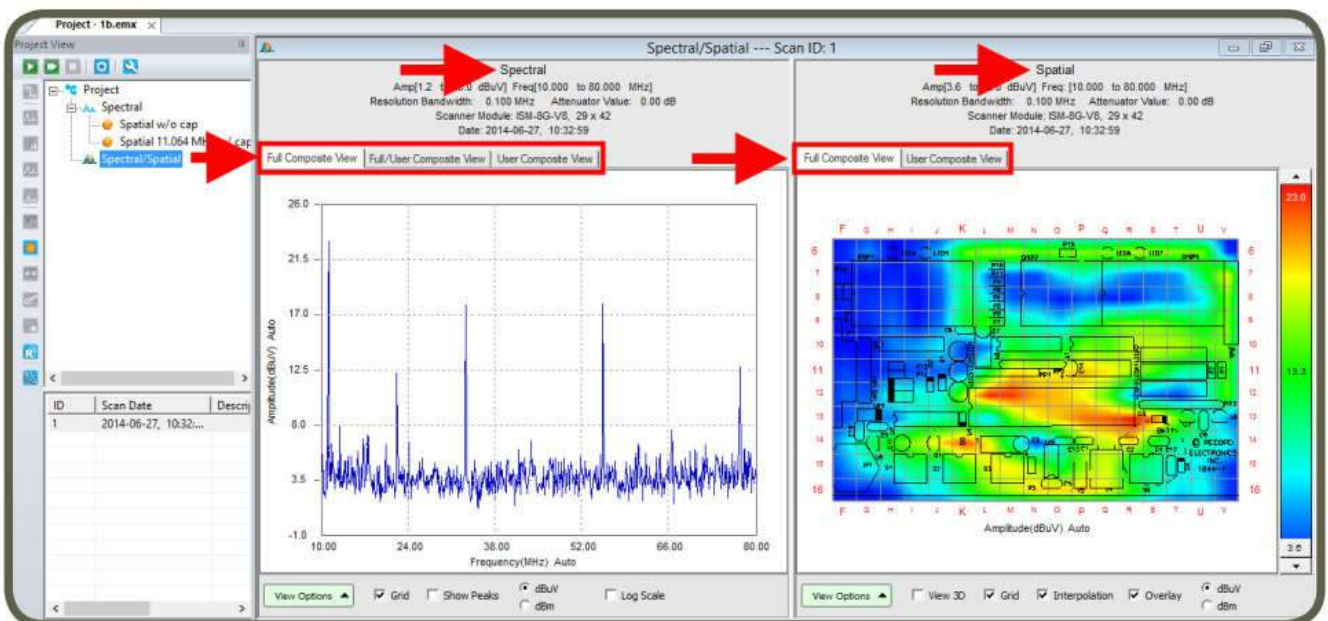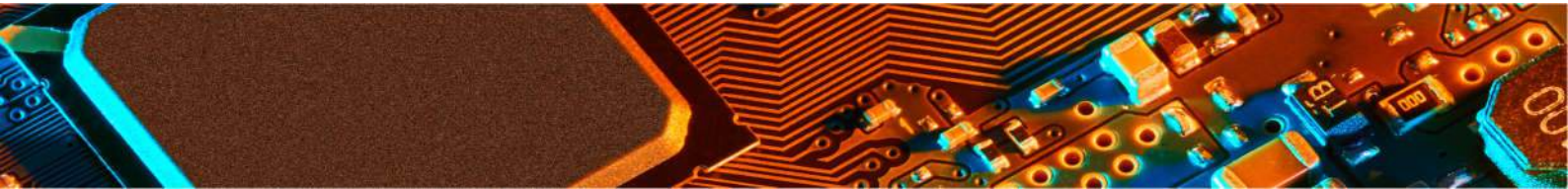

Description Tab
You can name the node and add a description. Click OK.
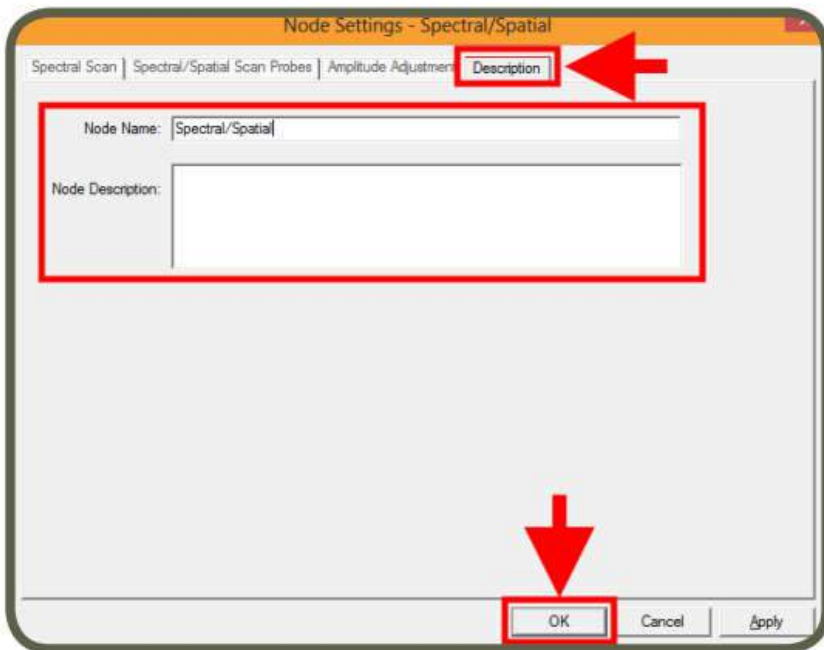
To run the scan, click. Once the scan is completed, a spectral view and a spatial view will be displayed. By default, view tabs are set to full composite spectral and spatial views for the entire selected frequency.

Full Composite Spectral View

Composite Spectral looks like a normal Spectral Scan however it is a gateway to archived spatial data for each frequency. You can select single or multiple frequencies on the Composite Spectral view to analyze the location of them on the board. Select Full Composite View under spectral graph and User Composite View under spatial view.

Single Frequency Marker
Single Frequency Marker is selected by default. Click on the frequency of interest on spectral graph. A red cross will indicate the selection. Spatial graph will update to display the emissions on the board at the selected frequency. Selected frequency will be displayed under Freq List (Frequency List) next to the spatial graph.
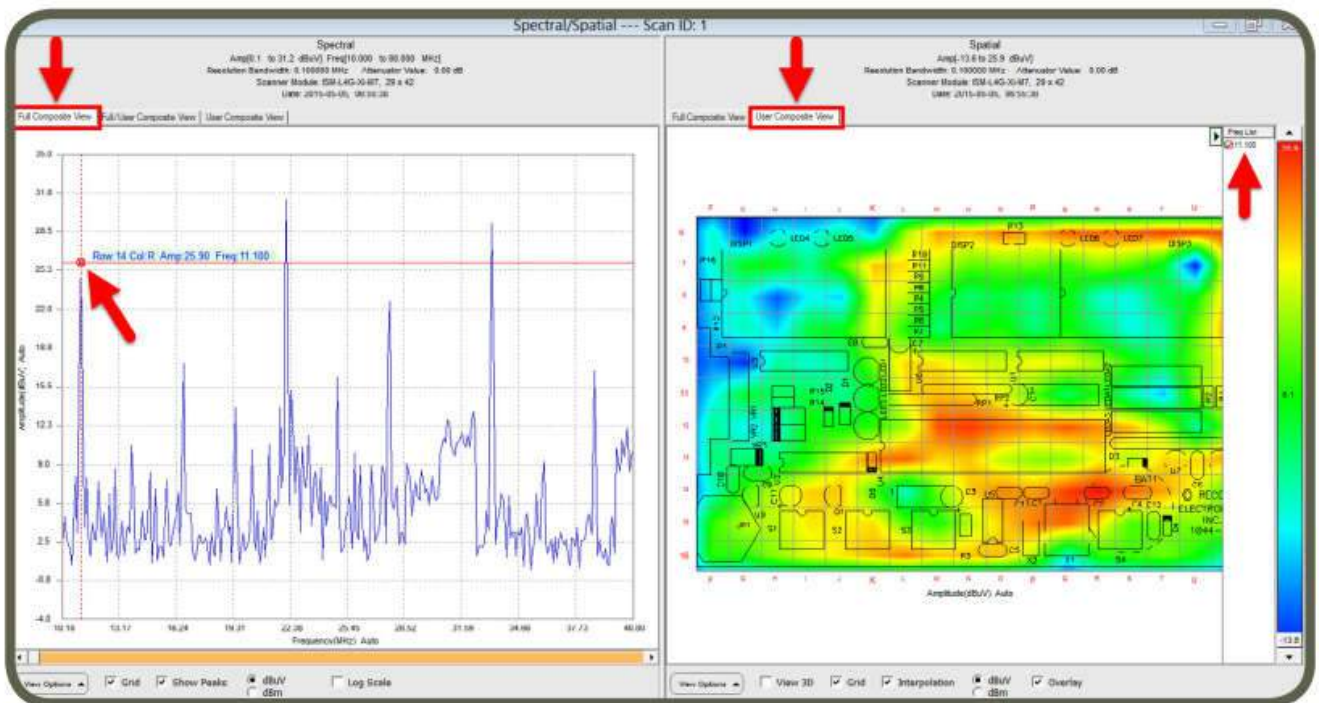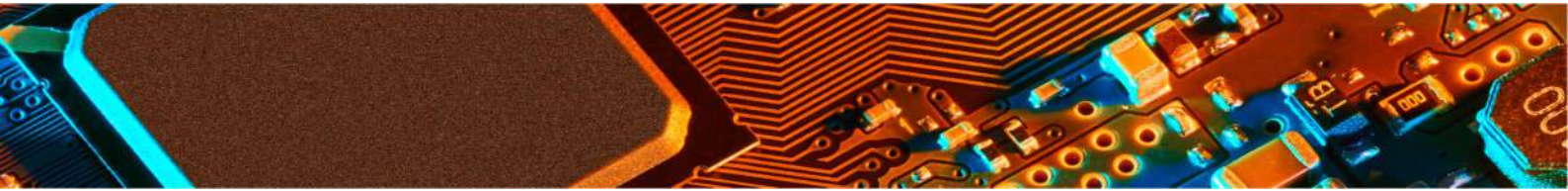

Multi Frequency Marker
Right click on the spectral graph and select Multi Frequency Marker.
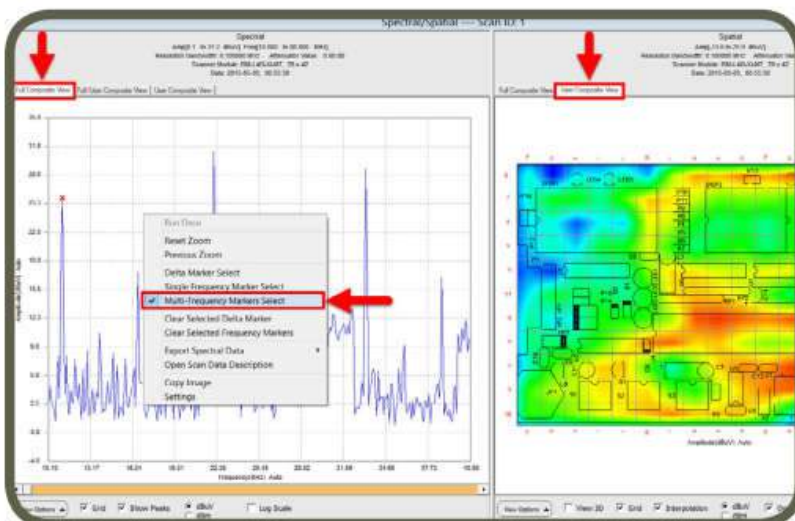
Select multiple frequencies of interest on spectral graph. A red cross will indicate the selection. Spatial graph will update to display the emissions on the board at the selected frequencies. Selected frequencies will be displayed under Freq List (Frequency List) next to the spatial graph. The amplitude and frequency displayed for each cell will be the maximum amplitude for that cell across the selected frequencies.
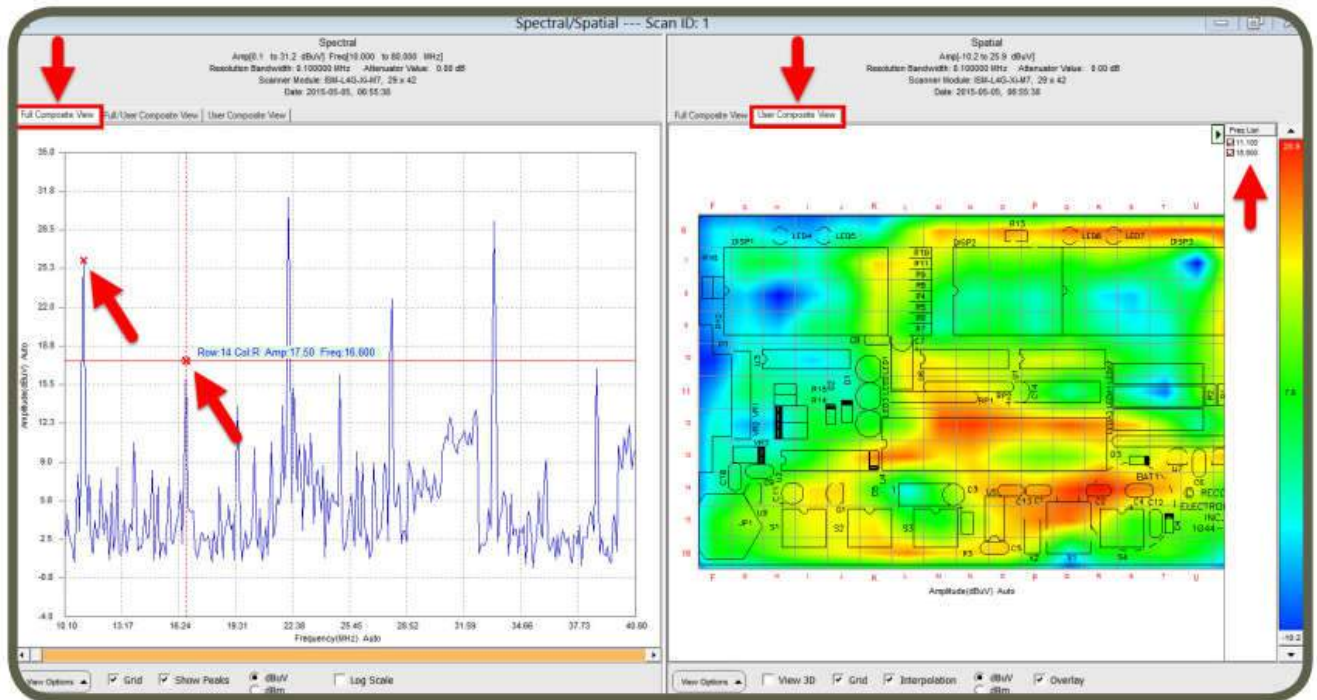

To clear frequency markers, right click on the spectral graph and select Clear Selected Frequency Marker.

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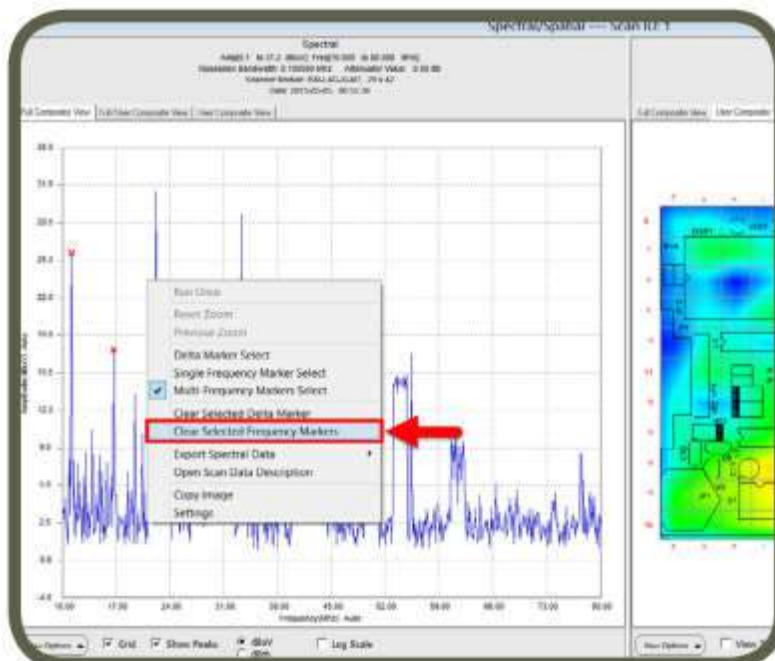
Delta Marker

It displays the amplitude and frequency difference between the current mouse position and the delta marker position in the frequency spectrum viewed.

1. Select either Full Composite View or User Composite View on spectral graph
2. Right click on the spectral view
3. Select Delta Marker Select
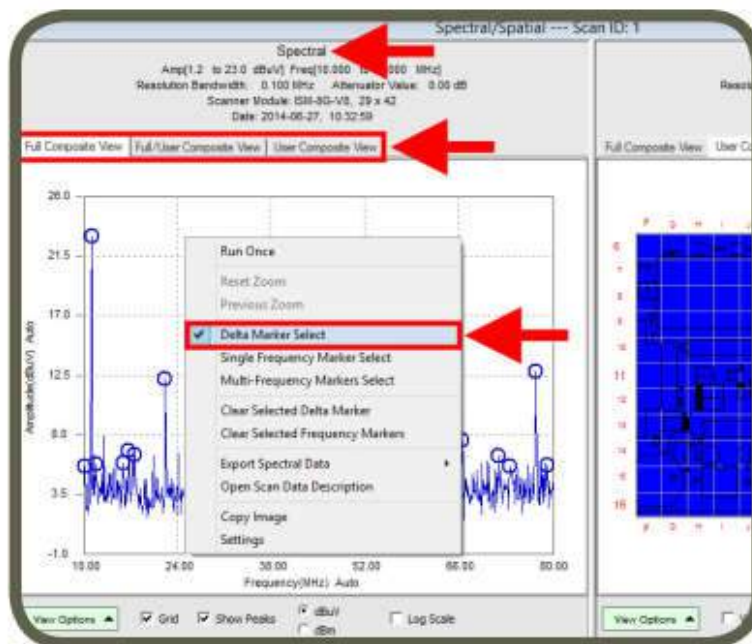
4. Move the mouse to the desired position to measure the delta. In the example below, delta marker is set at 11.100 MHz and the mouse is moved over to 33.100 MHz. Both are displayed above the spectral graph.
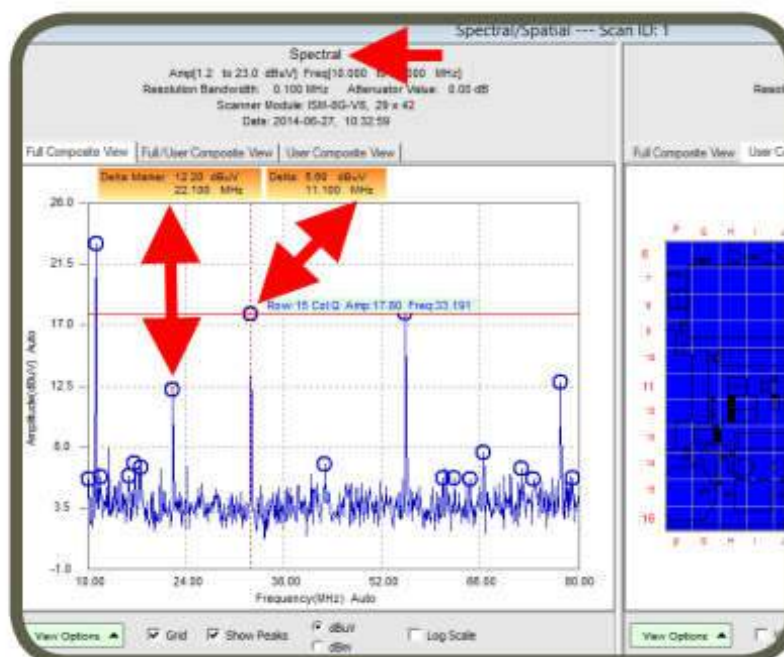
5. To clear delta markers, right click on the spectral graph and select Clear Selected Delta Marker
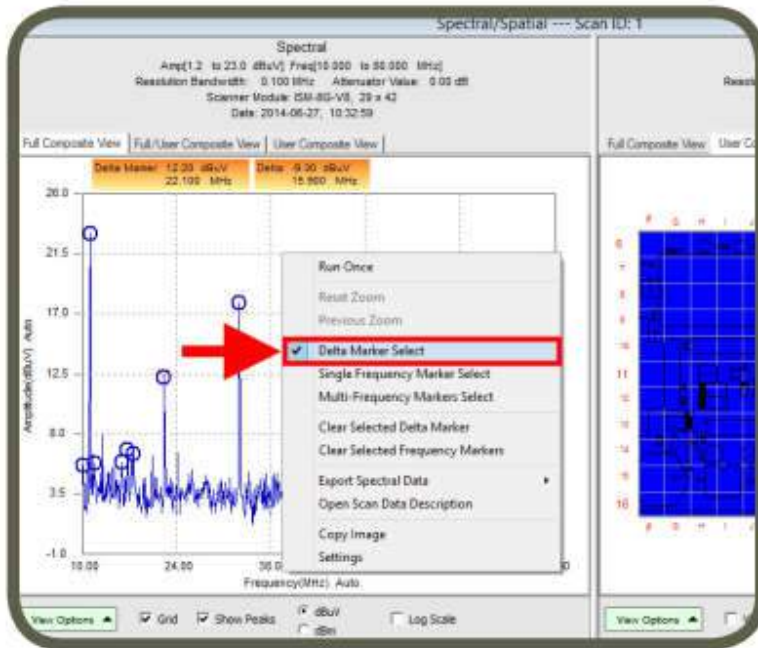
Full Composite Spatial View

Composite Spatial looks like a normal Spatial Scan; it however is a gateway to the archived spectral data for each frequency. You can select single or multiple cells on the Composite Spatial view to analyze their amplitudes and frequencies. Select Full Composite View under spatial graph and User Composite View under spectral view.

Single Frequency Marker
Single Frequency Marker is selected by default. Click on the cell of interest on spatial graph. A cross will indicate the selection. Spectral graph of the selected cell will be displayed in green on the spectral graph.
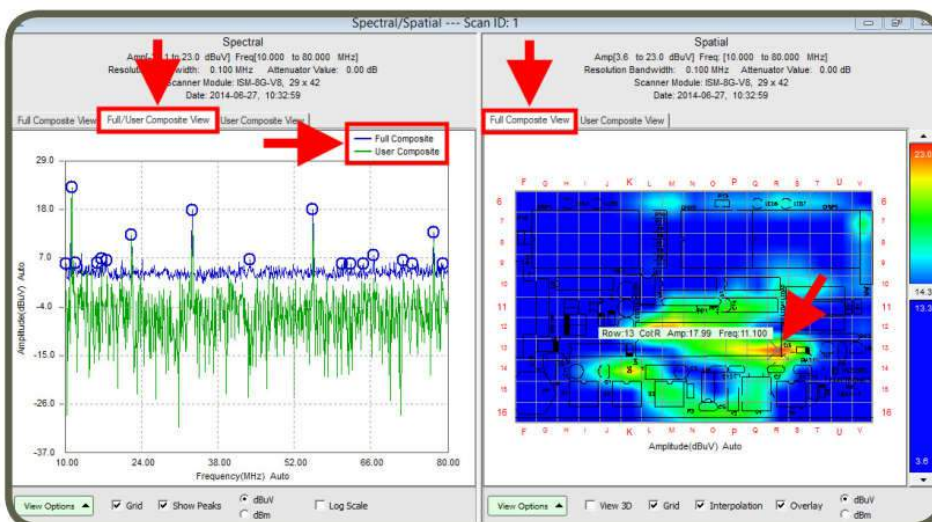
Multi Frequency Marker
Right click on the spatial graph and select Multi-Cells Select.
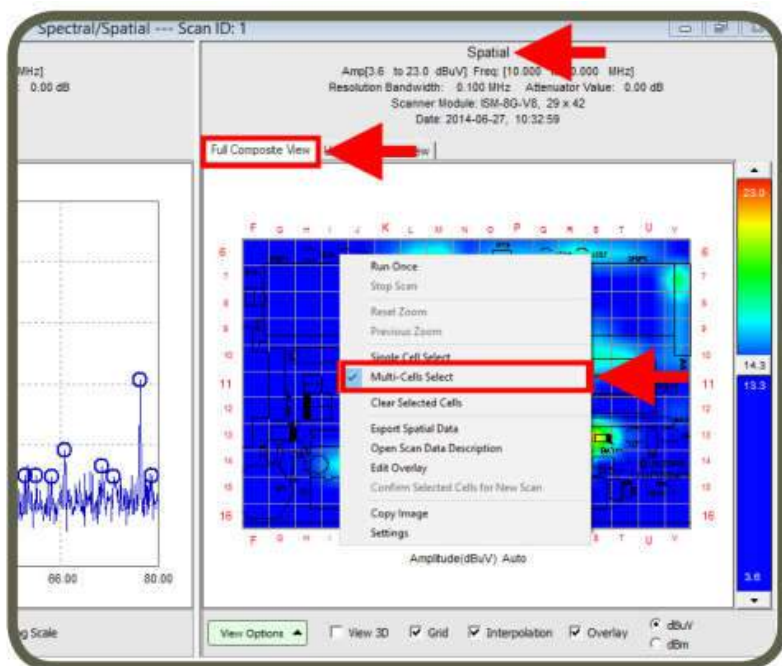
Select multiple cells of interest on spatial graph. A cross will indicate the selection. Full/User Composite View tab overlays spectral graph of user selected cells on to the full spectral graph. Spectral graph of the selected cell will be displayed in green on the spectral graph.
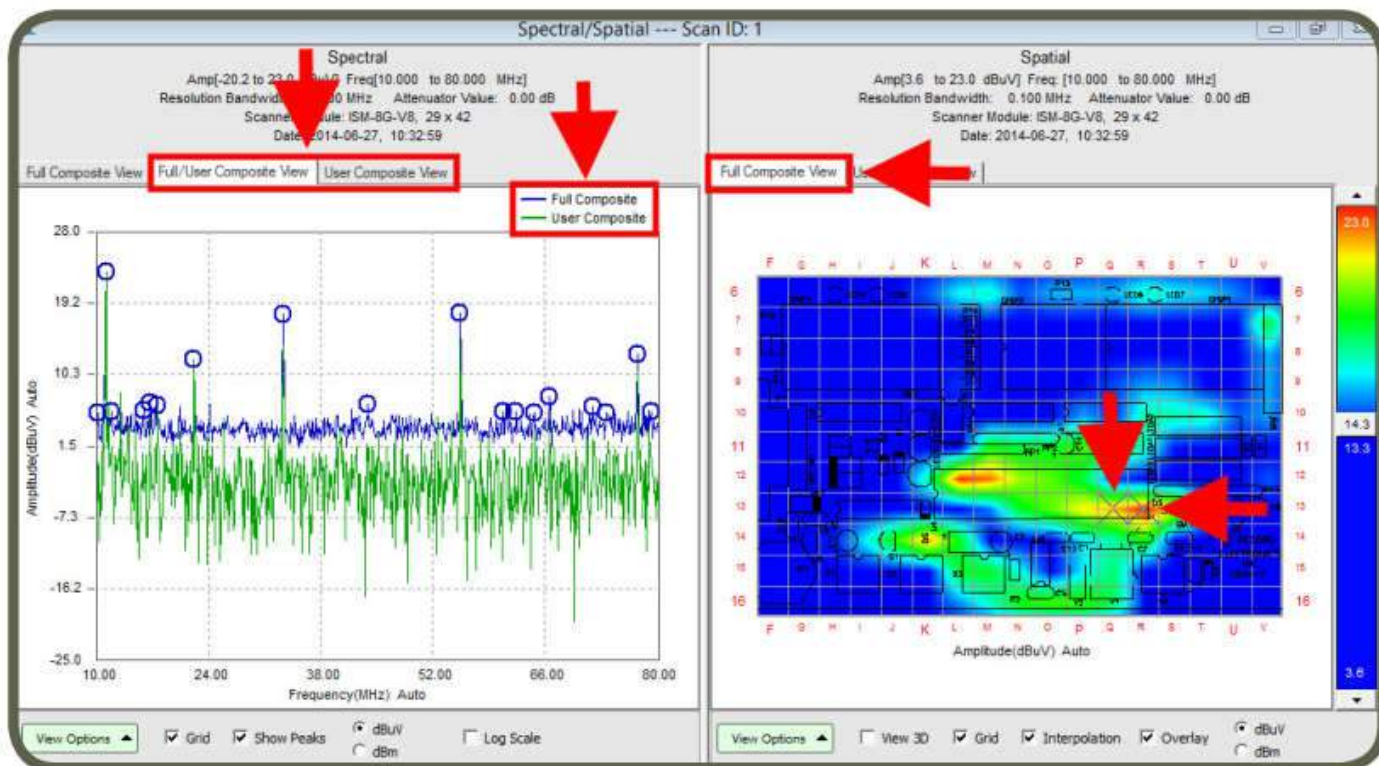
User Composite View tab displays the spectral graph of user selected cells.
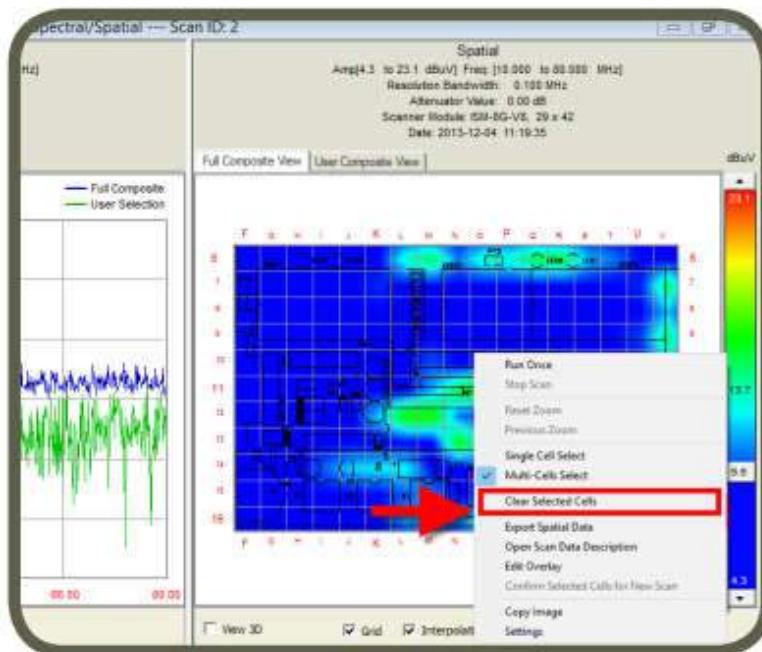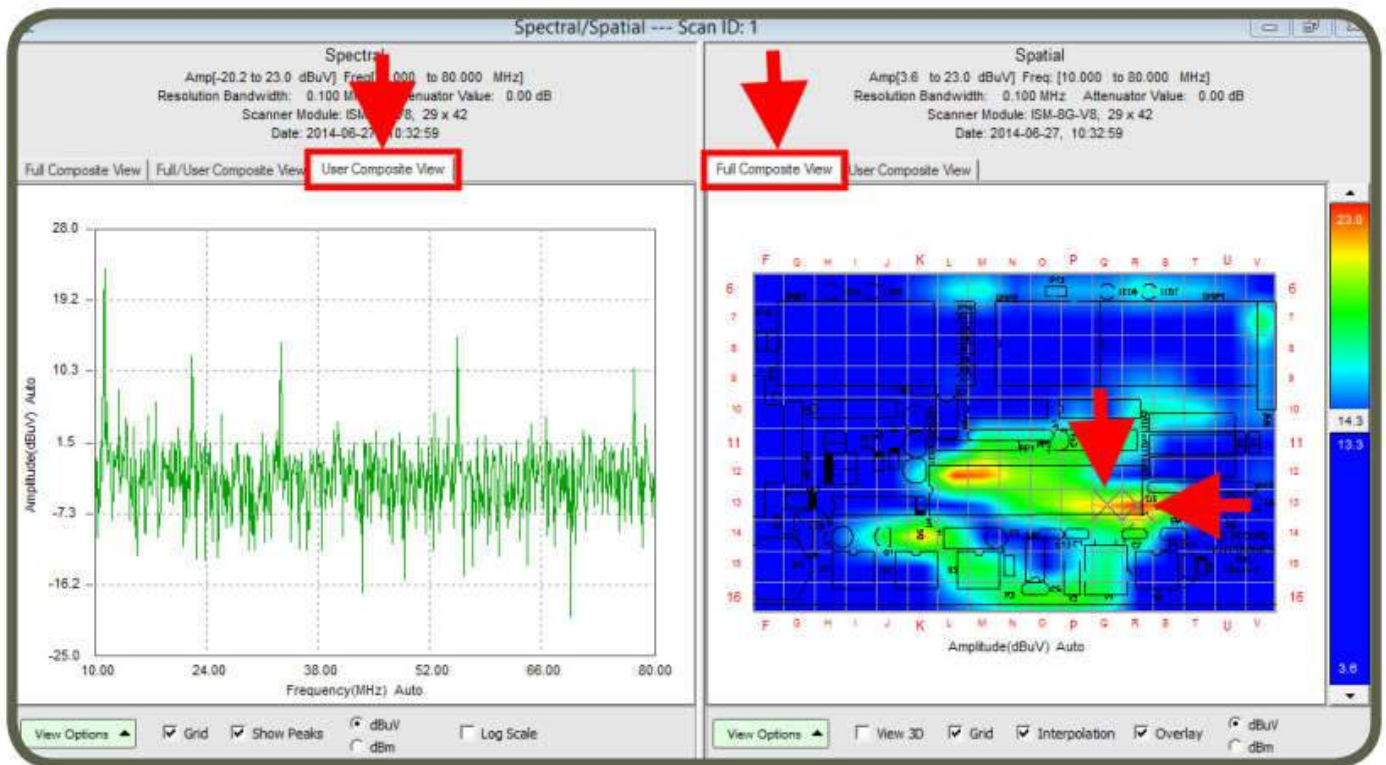
Description Tab
You can name the node and add a description. Click OK.
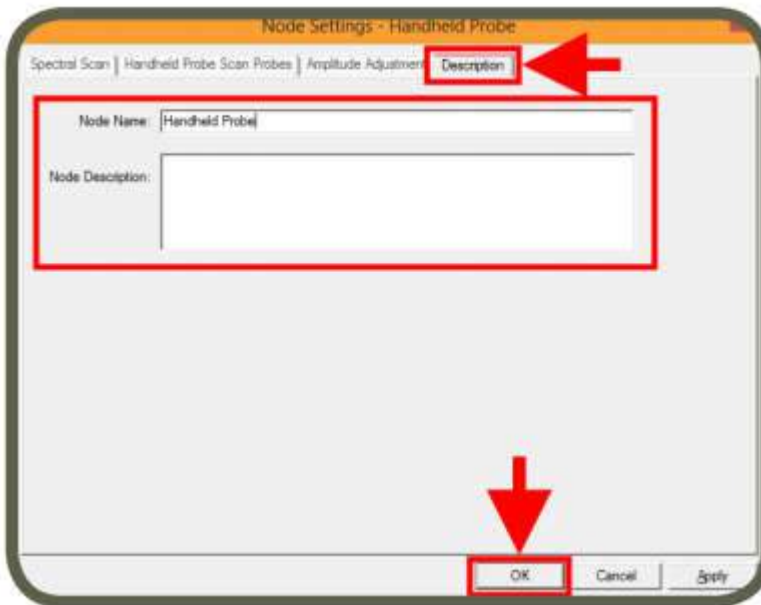
To run the scan, close the settings and run once. Immediately upon running the scan you see a message describing where you need to position the handheld probe.

Spectral Overlay

A Spectral Overlay is a qualitative comparison of two frequency spectra. It displays two data sets superimposed on each other, which allows you to visually inspect data for differences, i.e. presenting a qualitative view.

The Spectral Overlay node allows you to observe and compare two Spectral Scans with the same resolution bandwidth within their common overlapping range overlapping frequency range even though they may have different frequency ranges e.g.: Spectral 1: 10 MHz - 80 MHz and Spectral 2: 30 MHz - 120 MHz.Add Spectral Overlay node to Project node. Node settings window automatically opens.
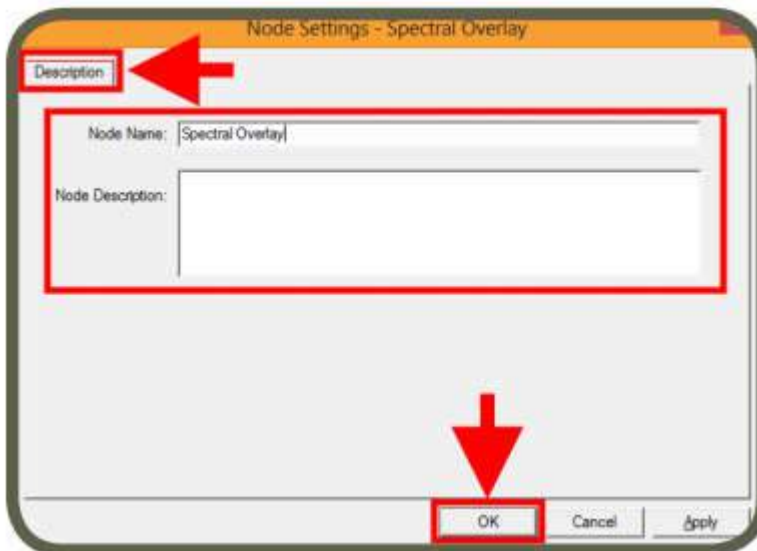
After you click OK, Spectral Overlay window opens. Go to the Spectral View. Select the data from the data list that you want to overlay and click & drag & drop it on to Test View. Repeat these steps for the second data and drop it on to Reference View. Click Overlay View tab and mouse over the graph.
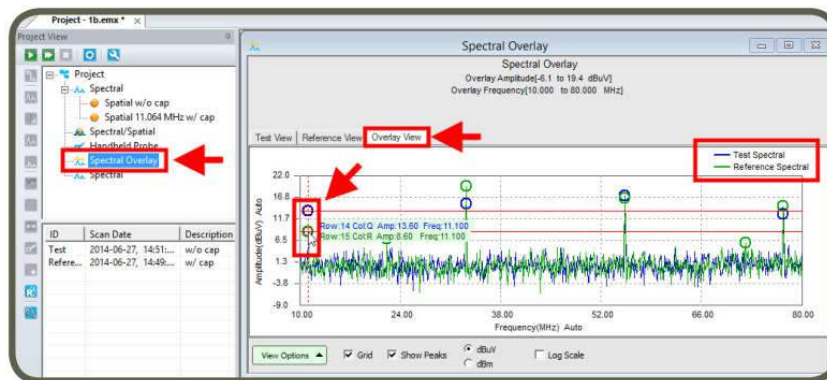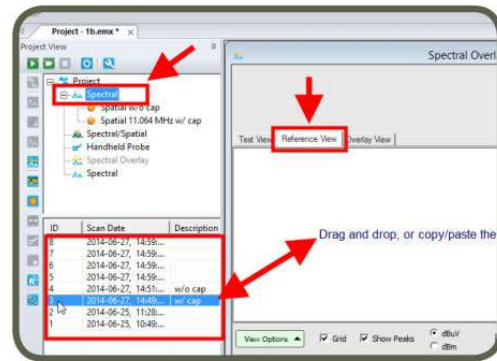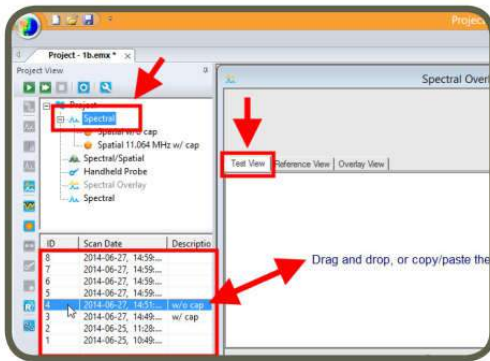
Spectral Comparison

A Spectral Comparison is a quantitative comparison between two frequency spectra. It is generated by subtracting the values of one spectrum (Test View) from the values of the second spectrum (Reference View) at each frequency. The Compare Spectral node allows you to observe and compare two Spectral Scans with the same resolution bandwidth within their common overlapping range even though they may have different frequency ranges e.g.: Spectral 1: 10 MHz - 80 MHz and Spectral 2: 30 MHz - 120 MHz. A common use for this is to compare the spectral of a production device with the prototype device. This is especially important for conformance testing, where a prototype has received EMC approval and you want to compare production units to it. You would link the prototype spectrum to the reference node and compare the spectra from various production units

against it by linking them to the test node. Add Spectral Comparison node to Project node. Node settings window automatically opens. After you click OK, Spectral Comparison window opens. Go to the Spectral View. Select the data from the data list that you want to subtract from and click & drag & drop it on to Test View. Repeat these steps for the second data and drop it on to Reference View. Click Compare Spectral View tab and mouse over the graph to analyze the difference.
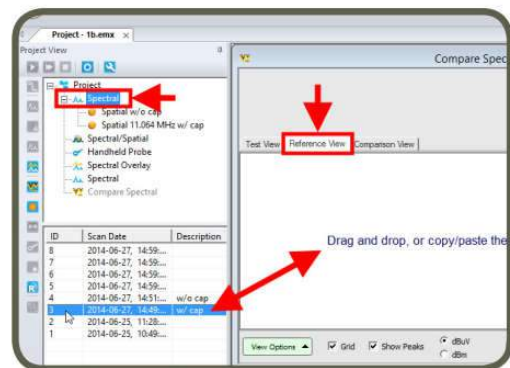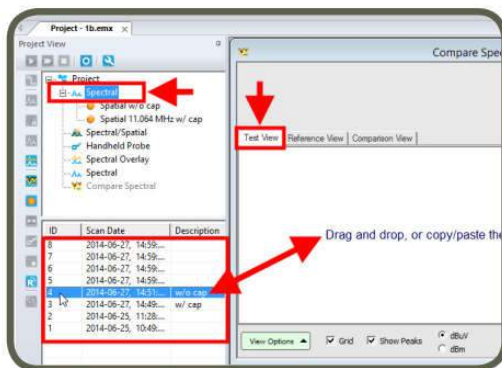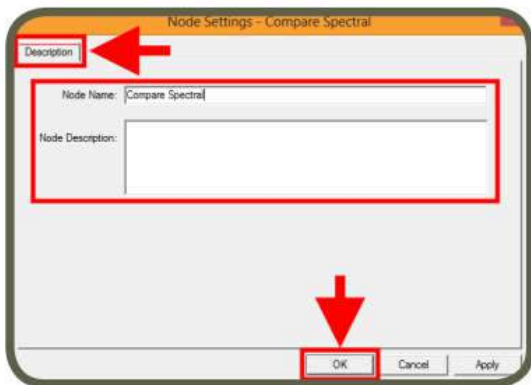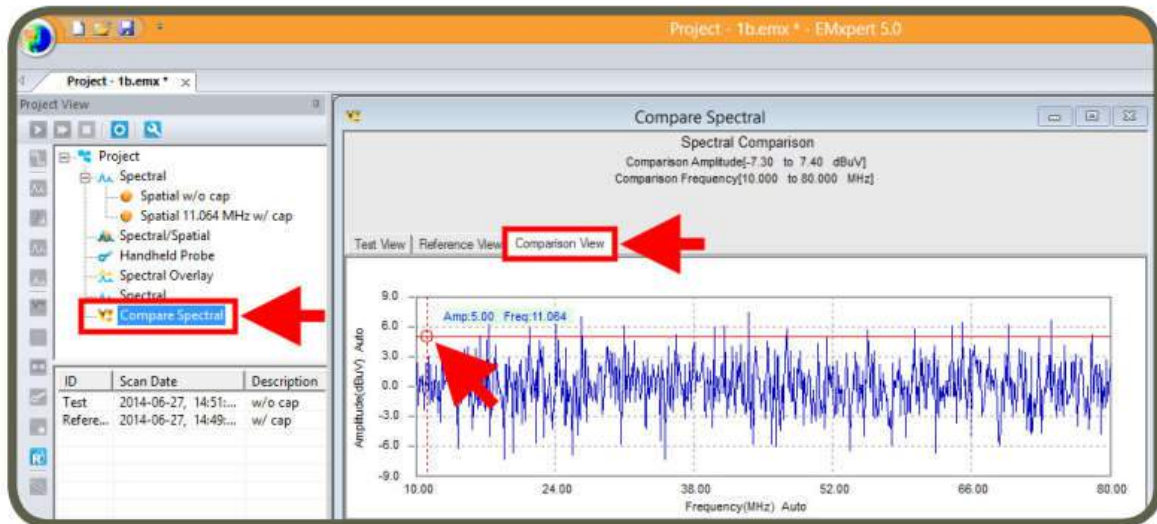
Spectral Blind Spot Reduction

For EMScanner & EMScannerR+

The Interleaved Scan is meant to overcome the limitations of the probe polarizations. Each of the 1218 probes on the EMScanner is created by using the vias and traces in a PCB to form a loop. This small loop does not respond well to magnetic fields parallel to it, essentially creating a blind spot. The response of a single probe to magnetic fields in a given orientation is shown below.
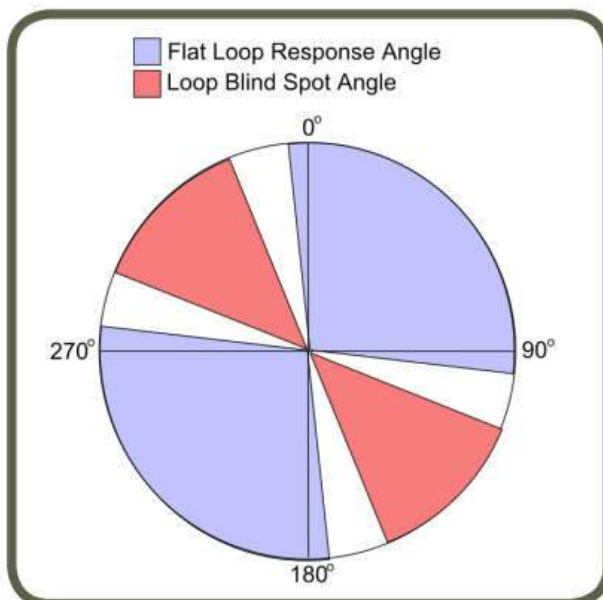
It was chosen to orient this blind spot at 45° and further to rotate every other row by 90° so that consecutive rows do not have the same blind spots. Because of this arrangement the blind spot can be eliminated by measuring a DUT twice with a small physical shift between scans.

For EMScanner & EMScannerR+ Model

Each of the 1218 probes on the EMScanner is created from two overlapping loops to increase their angular coverage. Even with this hybrid approach they do not have 360-degree coverage. There is one orientation of magnetic field that the probes do not respond to, essentially creating a blind spot. This blind spot can be eliminated by measuring a DUT twice with a small physical shift between two scans. A scale model of the probes is shown below. It effectively combines two separate loop probes into one "X Loop".
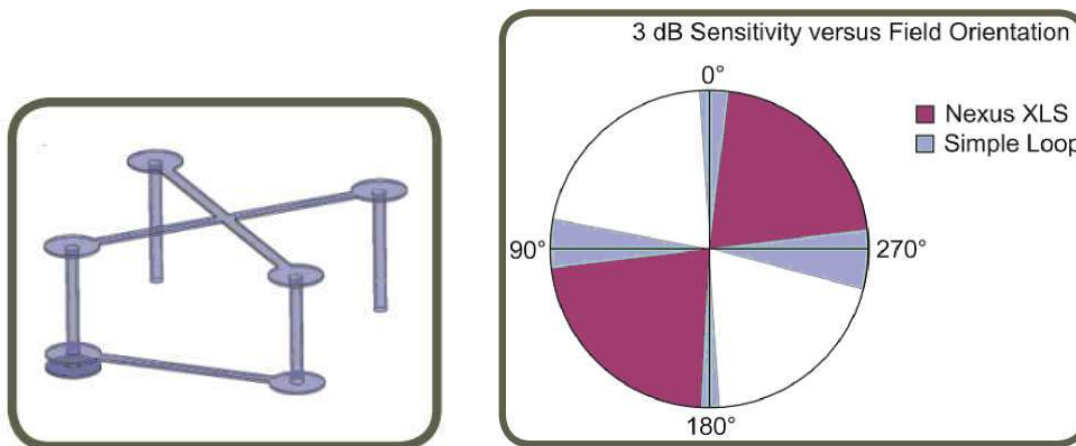
This setup is to provide a cumulative sensitivity as shown in the figure below.
This is a small 5x5 array taken from the larger 29x42 scanner. The effect of this different sensitivity on scan results sometimes shows up when
a device is rotated. If the device has only H-field components,
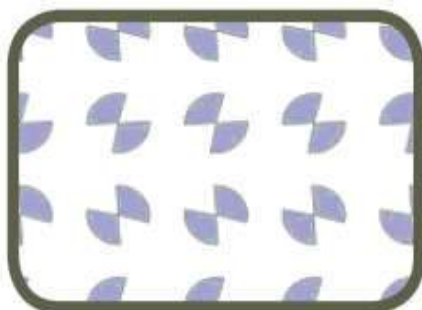
the scan results will be as shown in the top right of the graph
on the right. If this device is rotated 90° then results are as
expected and as shown below.
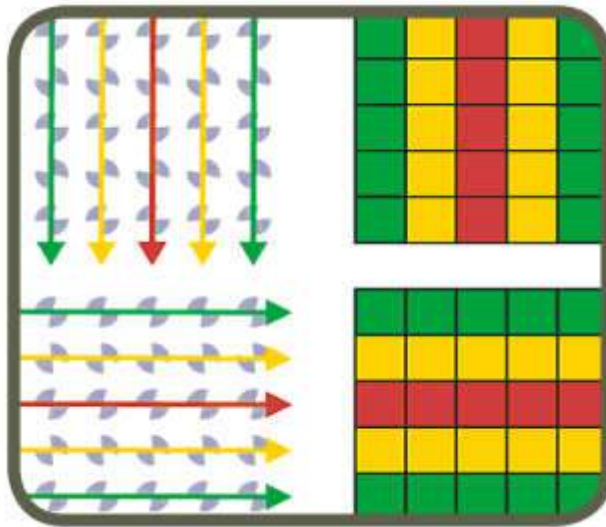
However, if the device has H-field components then every other row will have very low reception sensitivity. The scan results are shown below in the top right. Now if this device is rotated 90° then dead spots will switch to the alternate row. Although the high-level results are as expected, the presence of these low values distracts the eye. Furthermore, since the dead spots do not rotate, they may give the impression that the scan results are completely different.
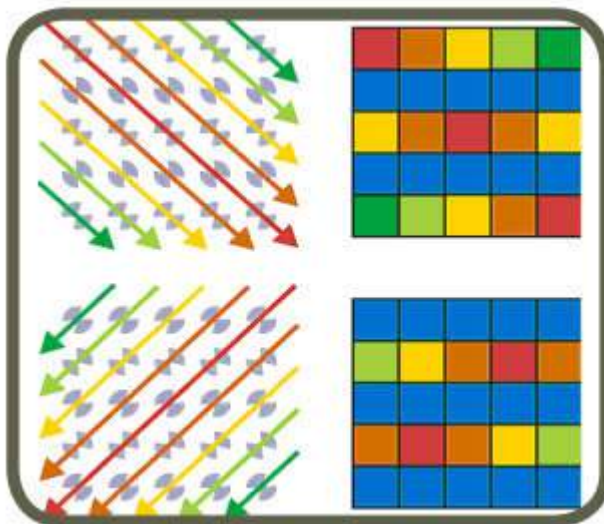
In certain situations, the presence of dead spots can create misleading results. An example of this is shown below. The image on the left shows a diagonal trace with one standard scan. The image on the right shows the same trace after two interleaved scans.
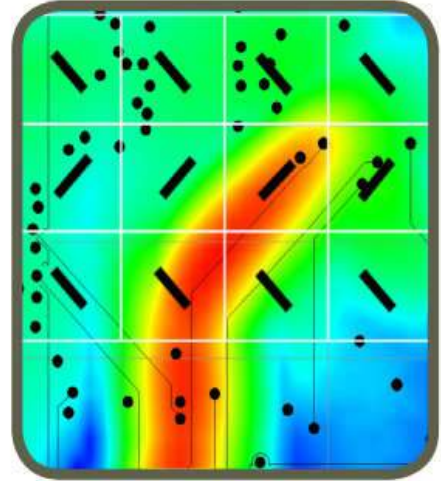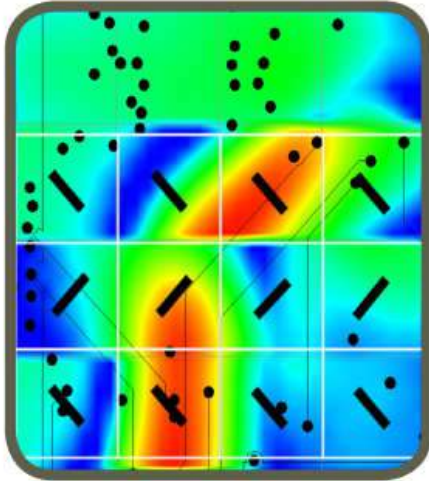
Creating a Blind Spot Reduction Node

1. *Interleaved Scan:*
a. Right click on the project node and select Add Node and then Spatial Scan node and check Interleaved Scan box
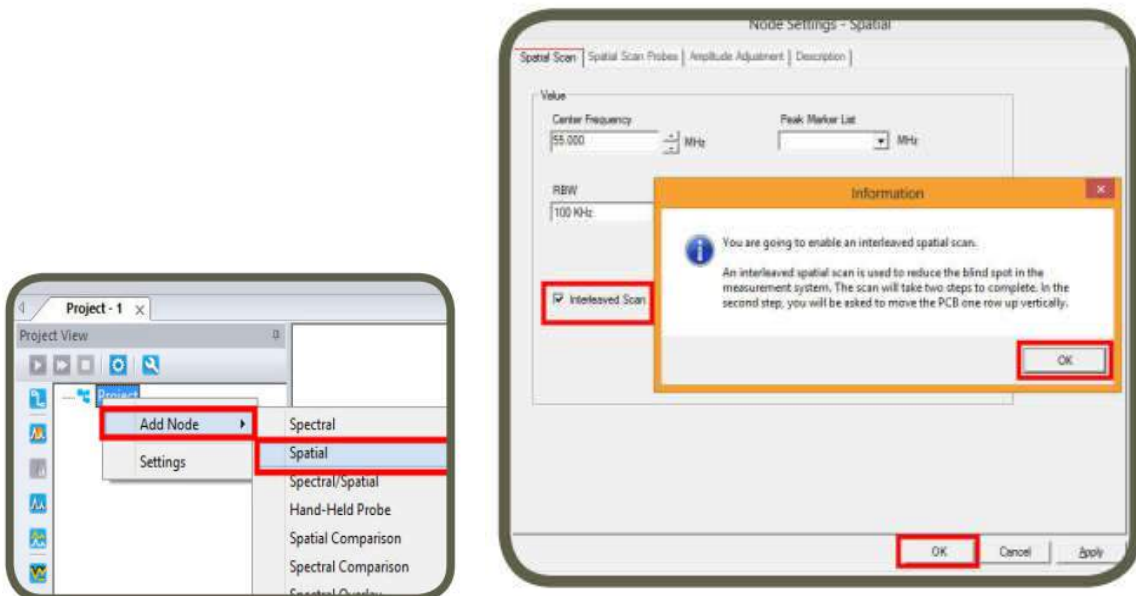
b. Run the first spatial scan: Place the DUT on the scanner at the desired position. This position should align with the Gerber file overlay. Run the first scan.
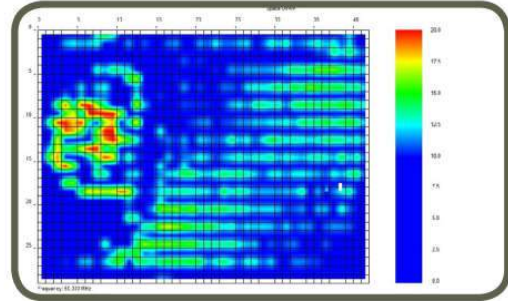
c. Run the second spatial scan: After the first scan, a message box will pop-up indicating to move the DUT up by exactly 1 row. Another way to describe the direction up is along the shorter axis towards the lower row numbers. Do not change the orientation or position along the longer axis of the board. After you move the DUT, click OK to run the second scan

Blind Spot Reduction

Frequency: 50.000 MHz
Resolution Bandwidth: 100.0 KHz
Scanner Module: ISM-L4G-Xi-M7, 29 X 42
Date: 5/3/2012 2:16:37 PM

Fixed   dBuV
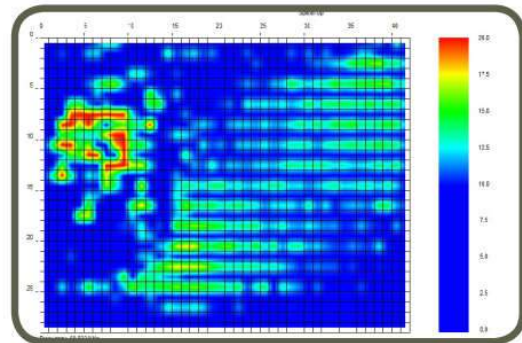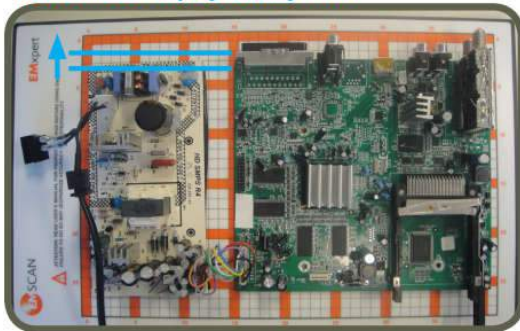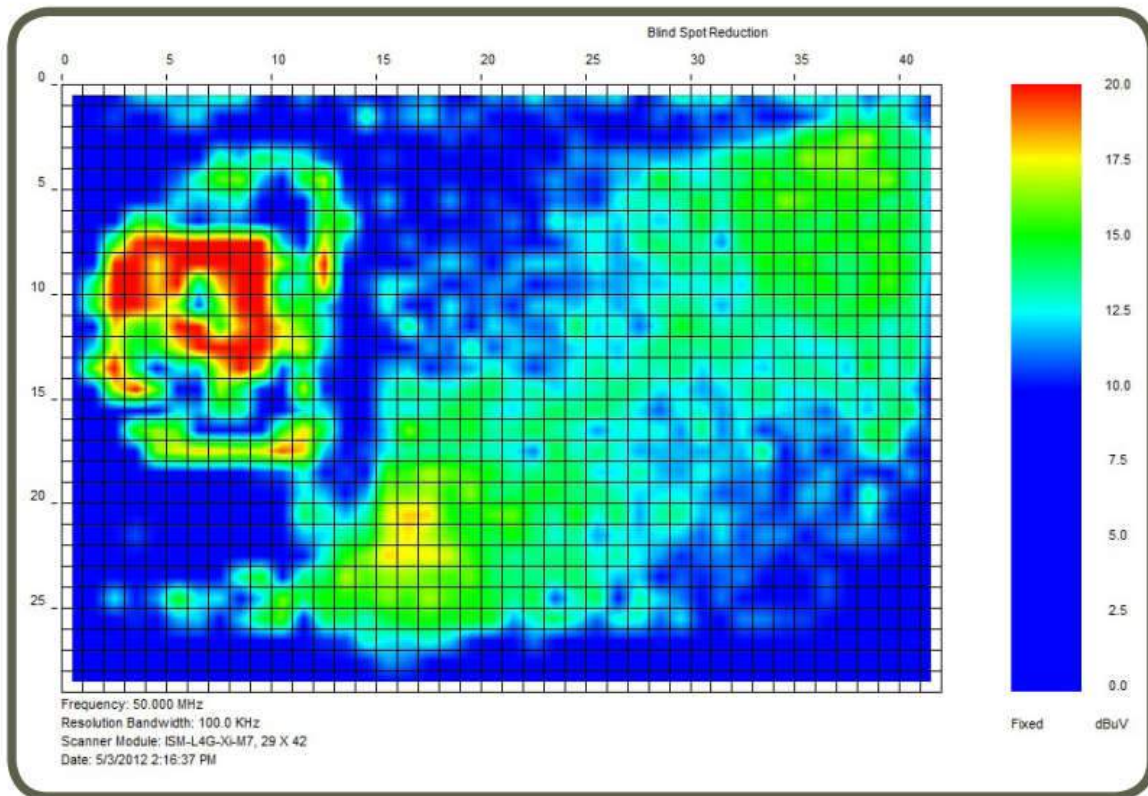
Spatial Comparison

Spatial Comparison is a quantitative comparison between two Spatial Scans that is generated by subtracting the values of the first scan (Test View) from the values of the second scan (Reference View) cell by cell. The Spatial Comparison node allows you to see the difference between two Spatial Scans at the same frequency.

You can use this feature to for example, find the failure point position in a production circuit board after a spectral difference has pinpointed a frequency that is significantly different between the two PCBs. This is useful for repairing faulty boards or pinpointing manufacturing process problems Two Spatial Scans that will compared must have overlapping cells. Add Spatial Comparison node to Project node. Node settings window automatically opens. After you click OK, Compare Spatial window opens.
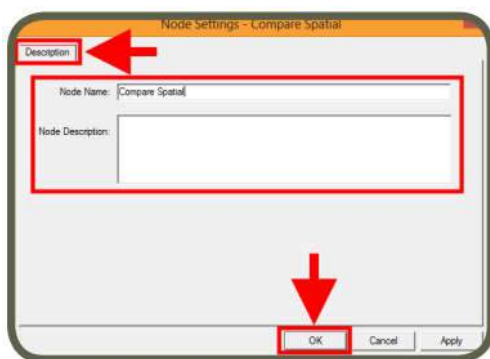
Select the data from the data list of the Spatial Scan that you want to subtract from and click & drag & drop it on to Test View. Repeat these steps for the second data and drop it on to Reference View. Click Compare Spectral View tab and mouse over the graph to analyze the difference.
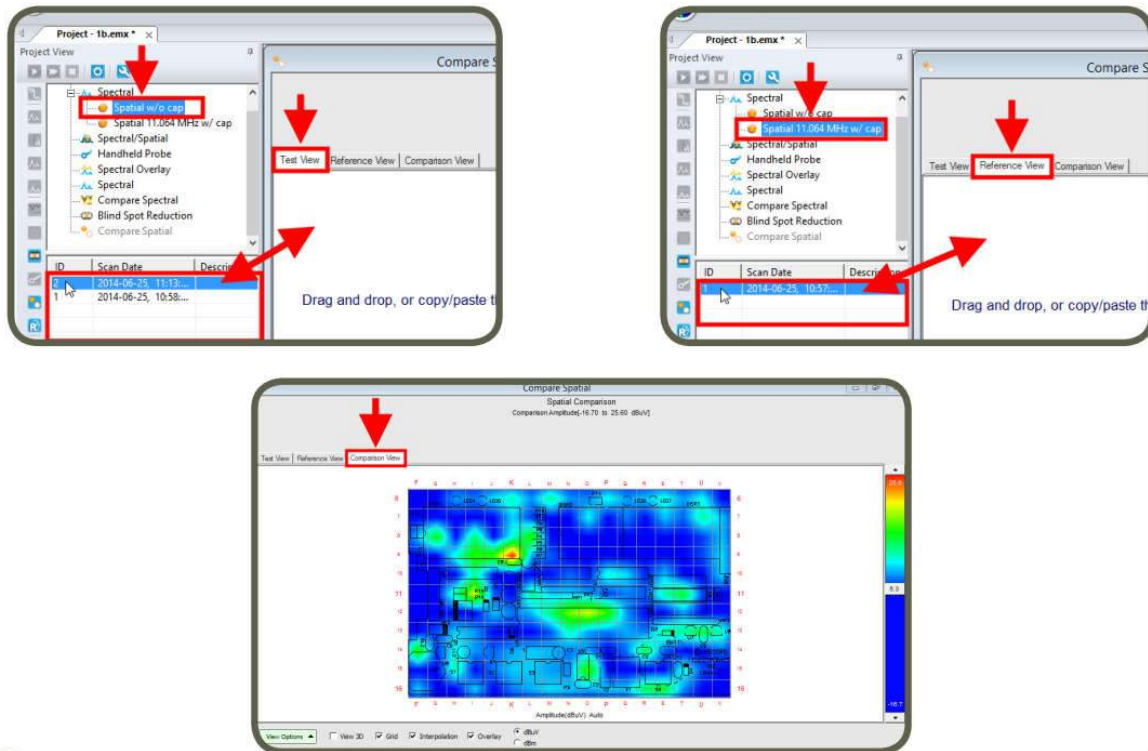
Measurement Tips

Scanning a PCB

Place the PCB on the scanner aligning it as closely as possible to the vertical and horizontal guidelines. Lining it up squarely assists you when importing overlays or images (JPG). When analyzing the emissions produced by a printed circuit board or device (DUT), verify that the signals are actually being emitted from the DUT and are not ambient background signals being retransmitted by the DUT:

1. Run a Spectral Scan over the frequency range of interest with the unpowered PCB on scanner. This is to eliminate the possibility that the DUT is acting like an antenna or signal conduit for non-local sources.
2. Power on the PCB and go through step 1.
3. Compare the powered and unpowered scans taken with the DUT in the identical positions and with identical scanning parameters to identify frequencies that have emissions emanating from the DUT. To determine the significant emission areas on the DUT at the frequencies of interest:
4. Perform a wide-frequency range Spectral/Spatial Scan or several Spectral/Spatial Scans to cover the entire frequency range of interest. Run Spatial Scans at the same frequencies

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used in Steps 1 and 2. If the peaks have not been measured accurately:

5. Run narrow Spectral Scans so that the frequency error of the spectrum analyzer is less than the bandwidth used for the Spatial Scan; e.g., for a spectrum analyzer with a frequency error of 1% of a scan, a Spectral Scan with a span of less than 10 MHz should be used for a Spatial Scan using a bandwidth of 100 kHz.

6. When measuring emissions above 6 GHz there is the possibility that surface waves on the scanner will degrade the rated isolation. To combat this effect a small surface wave absorber must be placed on the edge of the scanner. This absorber is provided by Y.I.C. Technologies with any 8 GHz EMScanner system.

If you are missing your absorber please contact Y.I.C. Technologies (support@yictechnologies.com)
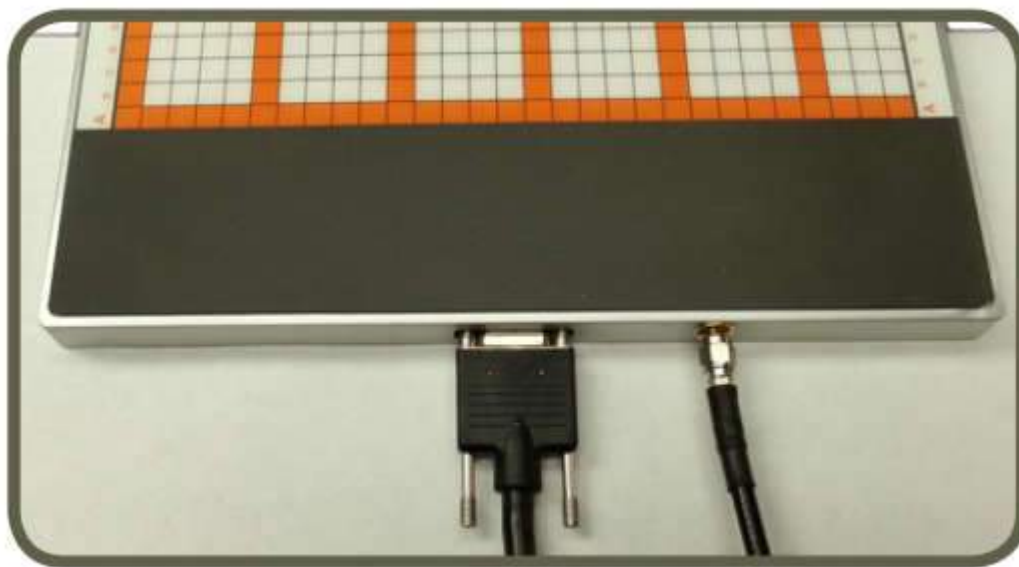
Scanning Best Practices

1. Choosing which scan to use. Is the device expected to have continuous emissions or intermittent activity? All devices have software-based activity and EMScanner ability to capture time-based feature can be very helpful.

a. If the device has some intermittent activity, select Continuous Spectral Scan with Peak Hold ON followed by a Continuous Spatial Scan with Peak Hold applied for each of the frequencies of interest.

b. If the device emits continuously, select Spectral/Spatial Scan.

2. Choosing Spans and Resolution Bandwidths (RBW). It is recommended that you scan a small frequency span with an RBW in the 120 kHz to 10 kHz range as it provides you with more immediate feedback. EMScanner has the capability of scanning all 1218 probes at a large span and a tight RBW but such scans can take a long time to complete.

3. Tips:

a. Take extra care during the setup of the DUT to ensure that the DUT is fully exercised in the fashion that will be sent off to a compliance test site (although it may not be in the final packaging).

b. Import a Gerber or HPGL overlay whenever possible. Carefully locate the overlay to coincide with the DUT as slight variations can be misleading. Make sure that the overlay is properly oriented. If the overlay file will be added afterwards take careful notes regarding the DUT placement on the scanner (coordinates), its orientation and the side of the DUT being scanned.

c. Set up a separate module or project for your DUT and use the 'Description' portion of the setup to quickly and easily identify the purpose of the scan.
d. Use the note facility for descriptions and possible explanations for emissions on the DUT. This could come in very handy later when writing a follow up report.
e. If you already have visited a compliance facility and have a report, it is a good idea to include this data in the notes and conduct the EMScanner scans at the same frequencies. There will be differences in the far-field and near-field values, but they will be relative.
f. If the scan amplitudes are below 20 dBuV and the noise floor is high, use a low noise amplifier (your own or one provided by Y.I.C. Technologies) and reduce the Resolution Bandwidth.
g. We take measures to compensate for spectrum analyzer noise.
h. Make special note of low amplitude current loops that are coupling onto the connectors.
I Conduct Spatial Scans using continuous scan and peak hold at some of the frequencies of interest, even if a Spectral/Spatial Scan was used. The Continuous Spatial with peak hold will almost always provide a different picture than a single Spatial or a single User Spatial of a Spectral/Spatial Scan (as all boards have time variances). The ability to capture time-based events is a benefit unique to Y.I.C. Technologies.
j. If you have a very strong intentional radiator, it may be advantageous to either conduct scans excluding this frequency (a scan below the frequency and a scan above the frequency) or add a passband filter (customer-provided) that selectively excludes this frequency.
k. If you are scanning very high amplitude intentional radiator an attenuator may be required.

Appendix – FAQ's

1. How can I correlate the scan results to PCB design?

2. Does the system require annual calibration?

3. What is the frequency and amplitude accuracy of the EMScanner measurements?

4. How do I achieve higher frequency accuracy?

5. I have a spectrum analyzer that is not on the list of supported analyzers, can it be supported?

6. How do I make sure that I see all the peaks that might cause me problems in the far-field?

7. What are the Minimum System Requirements?

8. What is the maximum power level that EMSCAN's patented scanner can receive without being damaged?

9. How sensitive is EMSCAN's patented scanner?

10. I added a low noise amplifier (or an attenuator) between the scanner and the spectrum analyzer and forgot to enter the value in the Amplitude Adjustment menu. Can I correct this without rescanning?

11. How can I find the frequency of an intermittent or random signal?

1. How can I correlate the scan results to PCB design?

EMScanner support three types of file formats: Gerber file format RS-274x, HPGL and JPG. On rare occasions, a Gerber file may not be in a pure RS-274x format and cannot be read by EMScanner software. This file can often be read by a third-party Gerber reader such as GerbView and converted to an RS-274x format that can be used. GerbView can be obtained at http://www.softwarecompanions.com/.

2. Does the system require annual calibration?

The EMScanner does not require calibration after shipment. The scanner elements are passive and will not require further calibration. If you believe that one or more of the probes have been damaged, the unit can be returned to Y.I.C. Technologies for verification and repair.

3. What is the frequency and amplitude accuracy of the EMScanner measurements?

Frequency Accuracy: Marked Peaks – Typically accurate to 1 kHz
A calibrated spectrum analyzer or EMC analyzer normally has a frequency error of between 1% and 2% of span. During the process of marking peaks, EMScanner conducts several rescans of identified peaks after the initial scan is completed. The final accuracy is 1-2% of the final scan bandwidth shown on the spectrum analyzer display.
Some supported models of spectrum analyzer provide higher accuracy frequency measurements using an internal counter. For these spectrum analyzers the final accuracy is the specified accuracy of the counter. Amplitude Accuracy: Spectral or Spatial Scans: approximately +/- 3 dB This is a combination of spectrum analyzer accuracy and probe factor responses from cell to cell across all frequencies from scanner to scanner.

4. How do I achieve higher frequency accuracy?

Frequency accuracy is compromised by the spectrum analyzer frequency measurement accuracy of 1% to 2% of span, unless the spectrum analyzer is equipped with a higher accuracy frequency counter. Therefore, by decreasing the span, the user can increase the frequency accuracy. Since EMScanner final rescan for peak detection is set at a span of 5 x RBW, reducing the RBW has the effect of improving the frequency accuracy.

5. I have a spectrum analyzer that is not on the list of supported analyzers. Can it be supported?

If your spectrum analyzer is not on the supported spectrum analyzer list, please contact Y.I.C Technologies (support@yictechnologies.com) to discuss the development of a custom driver.
Spectrum Analyzer must be configured with the following options to be supported: gated sweep, preamplifier, LAN or USB port, external trigger port with BNC connector and VISA support.

6. How do I make sure that I see all the peaks that might cause me problems in the far field?

There are instances where components of the DUT are some distance away from Y.I.C. Technologies scanner, and signals from these devices may be mixed with the noise floor. We recommend that a low noise amplifier be placed in series between the scanner and the spectrum analyzer to differentiate the signal from the noise floor. We also recommend that you reduce the RBW to improve the signal to noise ratio. It is important to recognize that some of the emissions may originate within the DUT, and then couple onto the connectors and cables (which may act as an antenna). The signals, at the DUT level, can be of low amplitude, while their far-field value (when conducted out and radiated), could be up to 100,000 times as large

7. What are the Minimum System Requirements?

- CPU 333 MHz or faster
- 128 MB RAM, 256 MB recommended for EMScanner, and 8 GB recommended for EMScannerR+
- 8 MB Video or more
- Windows XP/Vista/Windows 7/8/8.1 OS
- 10/100 Network Card

8. What is the maximum power level that EMSCAN's patented scanner can receive without being damaged?

The surface of the scanner can handle thousands of volts. The scanner is rated for a radiated load of 10 W or 40 dB. If a transmission line carrying RF power of more than 10 W / 40 dBm is placed close to the scanner probe for extended periods, it is likely to damage the scanner.

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9. How sensitive is EMScanner?

(* 30 dB LNA)
Sensitivity: -130 dBm to 35 dBm (Dependant on spectrum analyzer performance)

Frequency (MHz)	0.15	0.5	1	300	696	1500	2000	2600	3000	3500
Sensitivity	0	-15	-25	-68	-75	-79	-83	-85	-85	-86
Sensitivity with 40 dB LNA	-10	-25	-45	-90	-95	-100	-100	-130	-95	-100

Frequency (MHz)	4000	4500	5000	5500	6000	6500	7000	7500	8000
Sensitivity	-78	-68	-70	-75	-70	-65	-70	-60	-60
Sensitivity with 38 dB Power Amp.	-91	-85	-90	-88	-85	-90	-85	-70	-63

(* 40 dB LNA; ** 38 dB Power amplifier)

10. I added a low noise amplifier (or an attenuator) between the EMScanner and the spectrum analyzer and forgot to enter the value in the Amplitude Adjustment menu.
Can I correct this without rescanning?

If you forget to set the amplitude adjustment, you can re-enter the Amplitude Adjustment area and modify the processed scans without rescanning for all the types of scans.
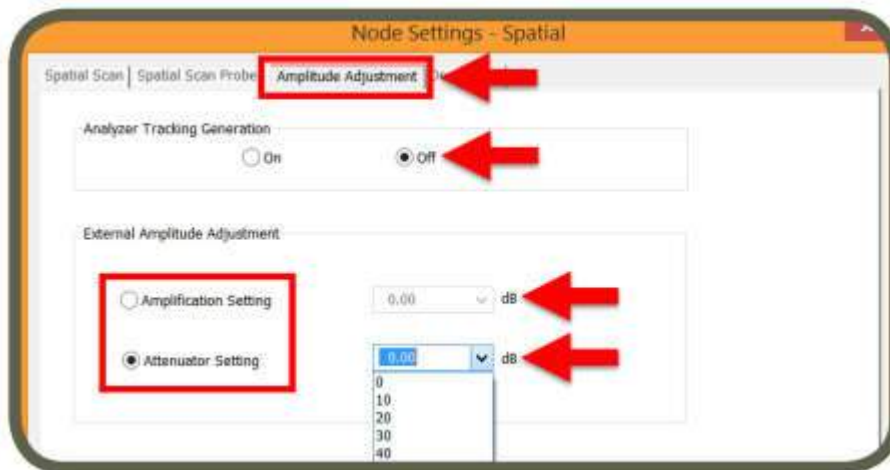
11. How can I find the frequency of an intermittent or random signal?

Run a continuous Spectral or Spatial Scan with Peak Hold. It will replace the peak amplitude with each successive higher measurement. Start with a large RBW to increase the speed of

the spectrum analyzer. Once you have captured the signal, reduce the frequency span and decrease the RBW if you want to improve the accuracy of the measurements.

12.Why does the peak marking process take longer than the estimated time?

EMScanner build a peak list initially during the Spectral Scan. Then it goes back to each peak and zooms in to make a more accurate measurement.

13.I am doing Before and After testing. What feature should I use?

Use either Spectral Overlay or Spectral Comparison feature.

14.Can I predict the Open Area Test Site (OATS) or Semi Anechoic Chamber (SAC) radiated EMI levels of a printed circuit board (PCB)?

The Far-Field Application supports regulatory compliance limits Class A or Class B FCC, CISPR and Industry Canada, 10 m, 3 m and 1 m test distances. This is an optional feature (Part #: 3000-0304) that can be purchased separately. Please contact Y.I.C. Technologies.

15.I want to do a Pass or Fail test. What feature should I use?

Use either Spectral Overlay or Spectral Comparison feature. You can also use the Threshold (Red/Green) display with Auto-scale off and set to the reference PCB emissions to see if a PCB under test is better or worse than the reference PCB.
To change the display colour to Threshold (Red/Green), click Preferences icon and go to the Display Options tab
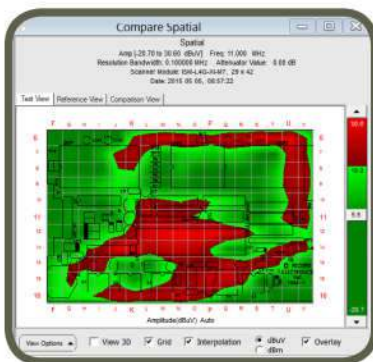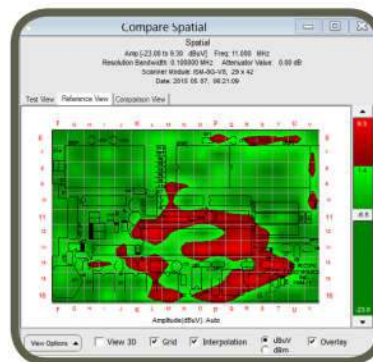
Defective PCB   Golden Sample   Pass/Fail Test

16. Why is the result of the Spectral Scan different than the image displayed on the spectrum analyzer?

EMScanner measures the DUT's emission on the surface of the scanner. The spectrum analyzer records the signal that is coupled by the scanner and transmitted to its RF input. However, there is an insertion loss and probe loss between the DUT and the RF input into the SA. These losses are different for each cell because the path is slightly different. EMScanner can compensate for this loss in each cell and across all frequencies.
The default for the software is to not compensate for these losses in which case the view in the EMScanner software and the image displayed on the spectrum analyzer should be the same. The user has the option of turning on this compensation and adjusting the measured results to account for these losses. If the compensation is set to ON in the setting, then this results in the EMScanner software viewer and the SA not showing the same magnitude in a spectral and spatial scan. The frequency of the peaks should be the same in either case.

17. How long does a typical Spectral Scan take?

EMScanner: It depends on the spectrum analyzer performance; for example to scan a 4" x 4" PCB with a span of 100 MHz and an RBW of 100 kHz with an Agilent MXA or a PXA takes a few seconds, close to 1; and if you remove peak marking which is a separate function of Spectral Scan it is even faster. Scanning area, span and RBW are user selectable.

18. How long does a typical Spatial Scan take?
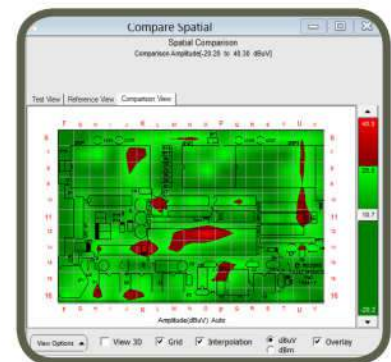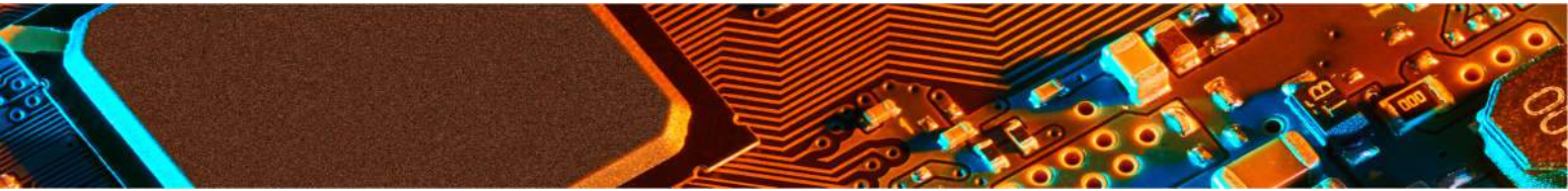
EMScannerR+: Less than one second though highly dependent on the spectrum analyzer performance.

19. I am designing multiple layer boards. How can EMScanner help to diagnose EM problems?

Currently, there are no measurement techniques on the market that can exactly see what is going on inside a multi-layer board. A chamber for example, will only deal with far-field and will not differentiate between what is coming from the edge, the most external layer, the internal layers, and the interaction between the layers. It is the most blind of all EMI test solutions to help design a better PCB with EMI reduction at the source. Automated single probe, handheld probe, and EMScanner can differentiate at least between the emission from the edge (where emissions from the internal layers will most likely escape and emit) and from the surface of the external PCB layers. If one uses a pre-amplifier, the scanner or probe could pick weaker signals from the internal layers leaking through the external layers. A comparison of the spectral and spatial analysis with or without amplification could then help point the source (frequency may help specify a component, and the location will do as well). Using the Gerber of the inner layers as overlay could help confirm the weaker emissions comes from a known PCB feature. The EMScanner and automated single probe could handle that; the handheld probe will not work.
Clearly, the EMScanner and the automated single probe are the only adequate tools for multi-layer PCB EMI measurements. However, the fact that the EMScanner is much faster and can track intermittent events through peak hold with continuous scanning, makes it the best solution overall.

Appendix – Error Messages

If you receive other error messages please contact Y.I.C. Technologies Technical Support: support@yictechnologies.com

Safety and Regulatory Information

The Spectrum Analyzer connected with an Ethernet cable to the Personal Computer (PC) must all together comply with CE emission requirements

• Read all of the instructions listed here and/or in the user manual before you operate this device. Give attention to all safety precautions. Retain the instructions for future reference.
• This device must be installed and used in strict accordance with manufacturer's instructions, as described in the user documentation that is included with this device.
• User must comply with all warning and caution statements in the instructions. Observe all warning and caution symbols that are affixed to this device.
• To prevent shock or fire hazard, do not expose this device to rain or moisture. The device must not be exposed to dripping or splashing. Do not place objects filled with liquids or chemicals on the device.

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• This device was qualified under test conditions that included the use of the specified cables, between system components. To ensure regulatory and safety compliance, use only the provided power and interface cables and install them properly.
• Different types of cord sets may be used for connections to the main supply circuit. Use only a main line cord that complies with all applicable device safety requirements of the country of use.
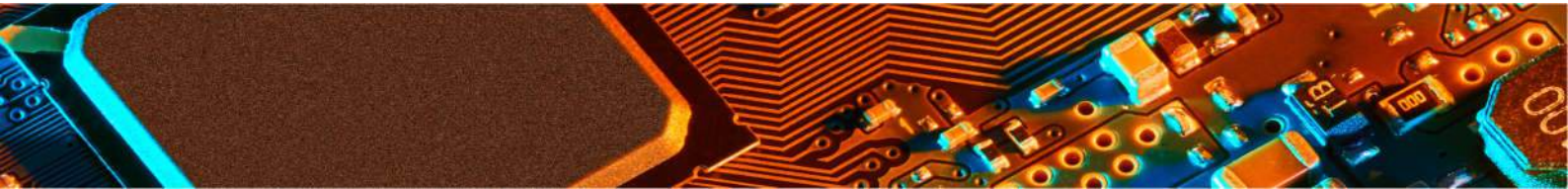• Installation this device must be in accordance with national wiring codes and confirm to local power company instructions and guidelines.
• Do not overload outlets or extension cords, as this can result in a risk of fire or electric shock. Overloaded AC outlets, extension cords, frayed power cords, damaged or cracked wire insulation, and broken plugs are dangerous. They may result in a shock or fire hazard.
• Route power supply cords so that they are not likely to be walked on or pinched by items placed upon or against them. Pay particular attention to cords where they are attached to plugs and convenience receptacles, and examine the point where they exist from the device.
• Place this device in a location that is close enough to an electrical outlet to accommodate the length of the power cord.
• Place the device to allow for easy access when disconnecting the power cord of the device from the AC wall outlet.
• Do not connect the plug into an extension cord, receptacle, or other outlet unless the plug can be fully inserted with no parts of blades exposed.
• Place the device on a stable surface.
• It is recommended that the customers install an AC surge protector in the AC outlet to which this device is connected. This is to avoid damaging the device by local lightning strikes and other electrical surges.
• Postpone installation until there is no risk of thunderstorm or lightning activity in the area.
• Do not cover the device or block the airflow to the device with any other objects. Keep the device away from excessive heat and humidity and keep the device free from vibration and dust.
• Wipe the device with a clean, dry cloth. Never use cleaning fluid or similar chemicals. Do not spray cleaners directly on the device or use forced air to remove dust.
• Do not use this product near water: for example, near a washbowl, or a laboratory sink.
• Do not open the device. Do not perform any servicing other than that contained in the installation and troubleshooting instructions. Refer all servicing to qualified service personnel.
• This device should not be used in an environment that exceeds 40º C and lower than 15º C.

FCC Class B Notice

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
• This device may not cause harmful interference.
• This device must accept any interference received, including interference that may cause undesired operation. Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
• Reorient or relocate the receiving antenna
• Increase the separation between the equipment and receiver

• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
• Consult the dealer or an experienced radio/television technician for help

Modifications: Any modifications made to this device that are not approved by Y.I.C. Technologies may void the authority granted to the user by the FCC to operate this equipment. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
Pursuant to Part 15.21 of the FCC Rules, any changes or modifications to this product not expressly approved by party responsible for compliance might cause harmful interference and void the FCC authorization to operate this product.

CE mark
EMScanner conforms to the following standards and other related normative documents:
• Electromagnetic emissions:
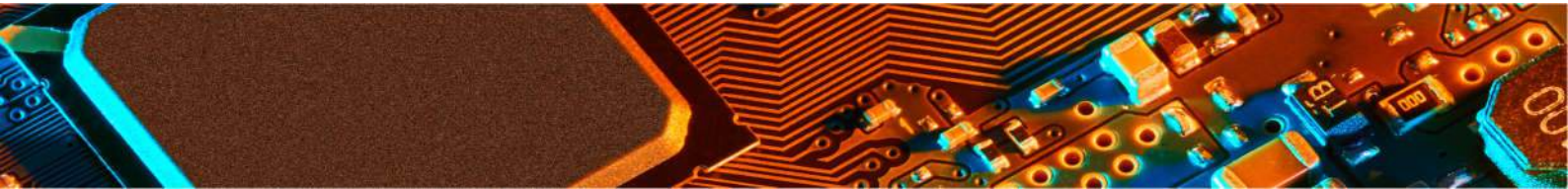(Council Directive 2004/108/EC–EN61326-1 Ed 2.0 2012-07. CISPR 11:2009,A1:2010) FCC Part 15 B
• Electromagnetic immunity:
(Council Directive 2004/108/EC–EN61326-1 Ed 2.0 2012-07 IEC61000-4-2:2008, IEC61000-4-3:2006 A1:2007, A2:2010, IEC61000-4-4:2004 A1:2010, EN61000-4-5:2005, EN61000-4-6:2008, IEC61000-4-8:2009)
• Safety:
(Council Directive 2006/95/EC-IEC/EN 61010-1) Marks of Compliance

About Y.I.C. Technologies

Y.I.C. Technologies is a world leading developer of FAST magnetic very-near-field measurement technologies and applications, providing real-time test solutions to antenna and PCB designers and verification engineers, without the need for a chamber. The EMScanner is a compact EMC and EMI diagnostic tool. Y.I.C. Technologies solutions dramatically increase designer productivity and substantially reduce time-to-market and project development costs.

support@yictechnologies.com
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