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TECHNICAL BULLETIN # 7

November 04, 2011

To: All NexusPlus and EMxpert Users

Re: Understanding Compensation

Background

The EMxpert scanner captures the magnetic near-field from the DUT. This field is coupled by the probes in the scanner and sent to the spectrum analyzer to be measured. The spectrum analyzer reports this value as voltage or power at its input port.

In order to get an accurate reading of the magnetic field strength from the voltage, an antenna factor or correction factor must be applied to the spectrum analyzer reading. At low frequencies, a large correction factor must in fact be applied because the probes are not very sensitive.

In order to help the user detect important signals the EMxpert can be configured by the user to apply this correction factor, called Compensation in the EMxpert. To highlight the signals this compensation is only applied to detected signals or peaks.

The mechanism for determining which sample points are peaks is very simple and can, in certain circumstances, be fooled. The basic mechanism is to first calculate the noise floor based on an average of all sample points. Then any sample point more than some user-defined threshold value above the noise floor is considered a signal and gets corrected.

This method works well in most circumstances but at low frequencies and in noisy circumstances there could sometimes be problems. This document will describe how to understand compensation and interpret the results, though at the end, it is still up to the user to decide whether it is being applied correctly.

Noise Floor

The noise floor itself can increase at low frequencies due to finite IF bandwidth. This can be seen on any spectrum analyzer and is shown below in figure 1. This is the data from a spectral scan with no input into the spectrum analyzer and no compensation applied. It is exactly what appears on the Spectrum Analyzer screen itself. The parameters for the spectral scan are 500 kHz to 30 MHz span with a 100 kHz bandwidth (RBW). The leakage power at low frequencies is very evident.

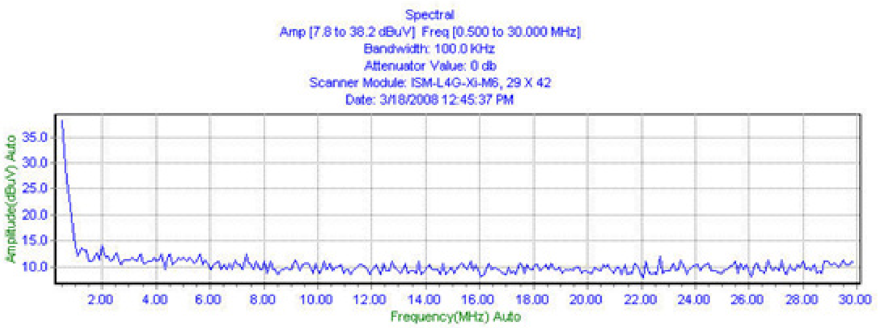

Figure 1 - Uncompensated Spectral Scan with no Input

In this case the average noise floor will be calculated to be 11 dBm. With a threshold value of 5 dB, any sample point above 16 dBm will be corrected. The compensated scan is shown in figure 2, again with no input.

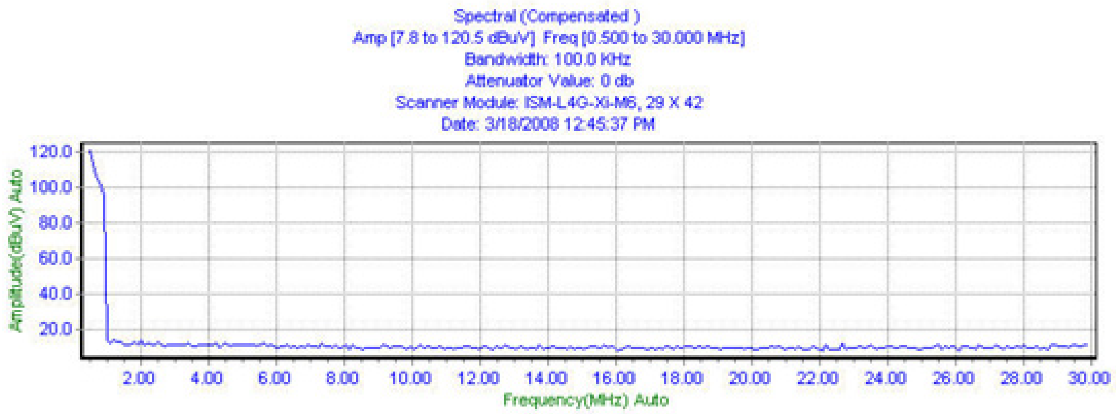

Figure 2 - Compensated Spectral Scan with no Input

The leakage power at low frequency is enough that it is pushed above the threshold and the compensation is applied. Because the correction value is very large the data is then presented in a manner which seems to indicate a signal presence.

Solution 1

Because the root cause of the error is the rising noise floor, the easiest solution is to eliminate leakage power. This can be done by reducing the IF bandwidth. The spectral scan shown in Figure 3 also begins at 500 kHz but because the IF bandwidth has been reduced to 1 kHz there is no noticeable noise floor increase.

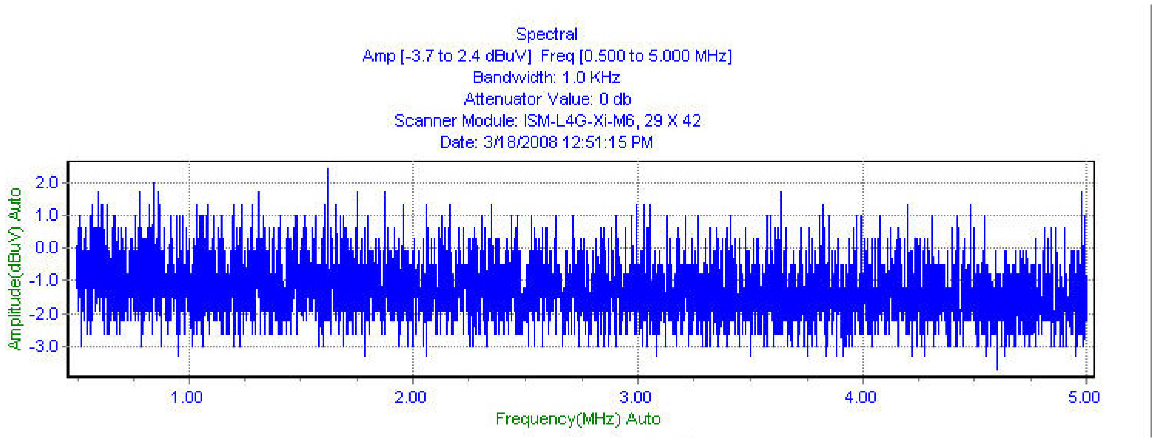

Figure 3 - Uncompensated Spectral Scan with reduced RBW

Now when the compensation is applied, there will be no false signal artifacts. This is shown in Figure 4; it looks very similar to Figure 3.

The downside of this approach is that a scan will take a longer time with a smaller RBW. There is also no firm rule on when the RBW is small enough although **10*RBW < Start Frequency** will generally be sufficient.

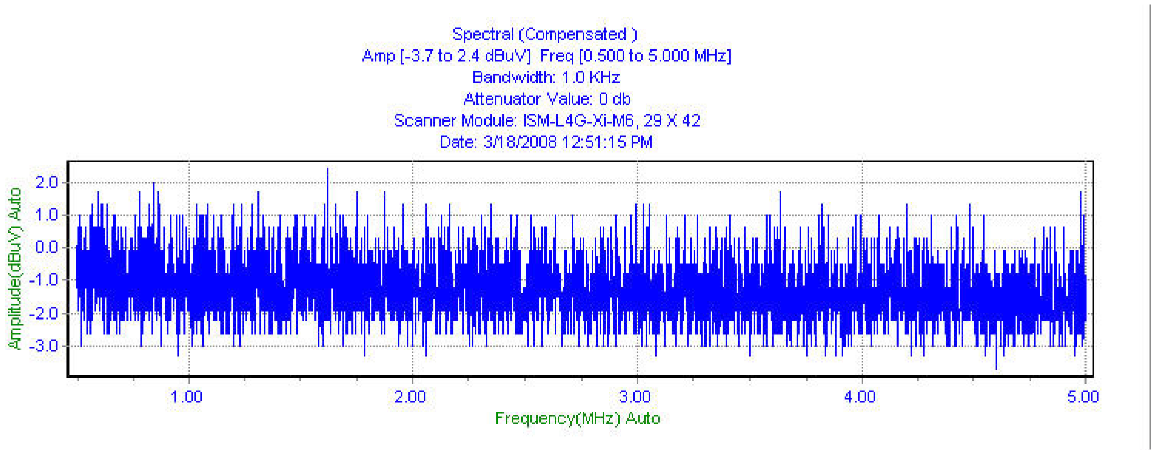

Figure 4 - Compensated Spectral Scan with reduced RBW

Solution 2

The second method assumes that the noise floor is increasing at low frequencies and avoids the problem by simply moving the threshold higher than the noise.

In the example below, now shown with a source present, the data is shown uncompensated. From this view, the user can decide which sample is signal and which is noise.

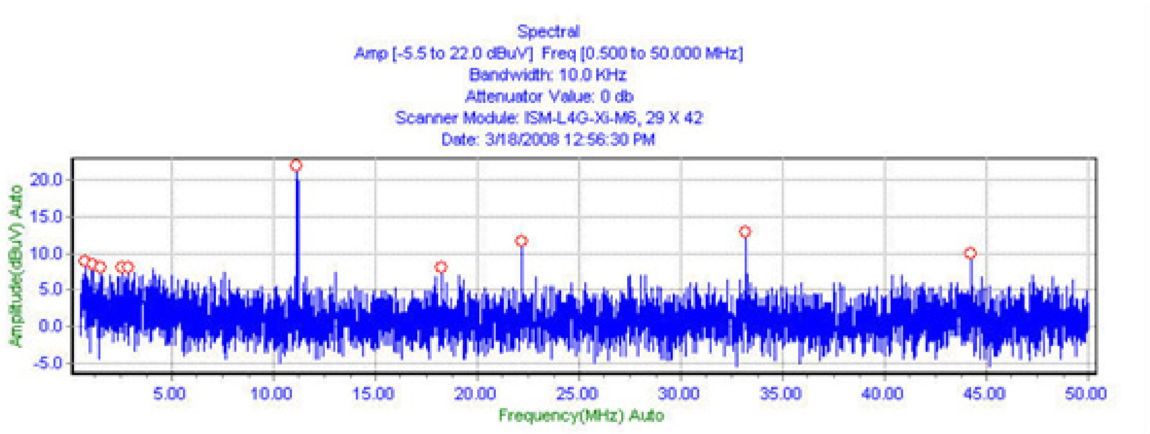

Figure 5 - Uncompensated Spectral Scan with Source Present

If compensation is turned ON with the default threshold of 5 dB, it should be obvious that some noise signals will be compensated. This is shown in Figure 6.

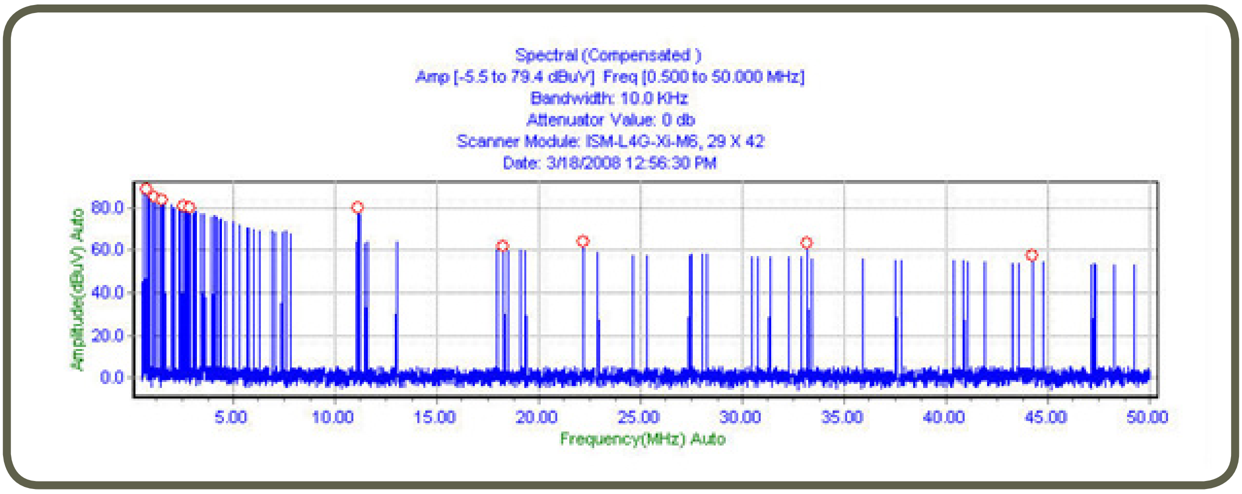

Figure 6 - Compensated Spectral Scan with Source Present and Low Threshold

To avoid this result the user can increase the threshold value so that only signals are compensated. This is shown in Figure 7.

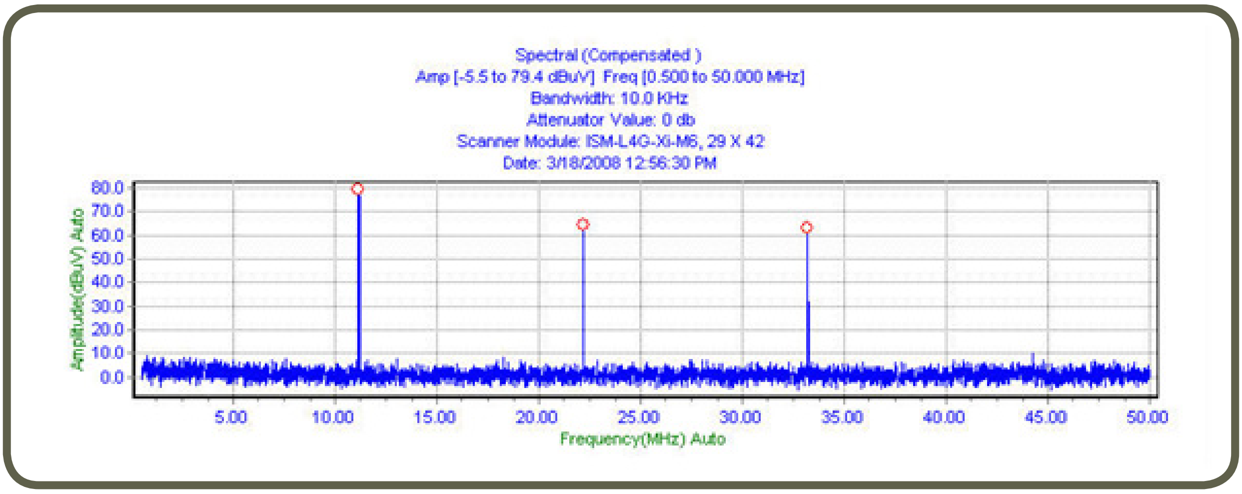

Figure 7 - Compensated Spectral Scan with Source Present and Higher Threshold

This method will work even in situation where there is low frequency leakage. The downside is that the user must decide which data points are signals and which are noise spikes. It will also have problems if the low frequency noise floor increases above the actual strengths of high frequency signals.

Compensation Settings

To alter the compensation as discussed in this document, there are two settings dialog boxes that must be changed. The first one is under the Spectral Scan Settings and can be accessed by right clicking a spectral scan. It is shown in Figure 8. The value that can be changed here is the ‘Peak Threshold Above Noise’.

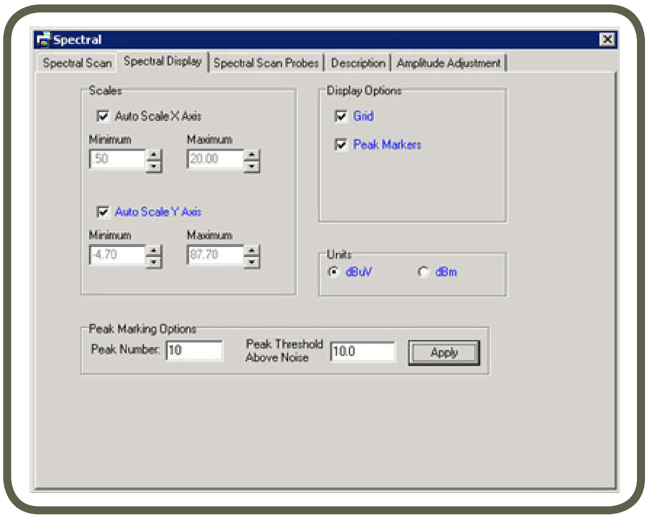

Figure 8 - Spectral Scan Settings for Threshold Value

The user also has the option of turning ON or OFF compensation; it is OFF by default. This can be accessed by the ‘Edit -> Preferences’ button on the main toolbar. The compensation for a spectral scan can be set on the ‘Spectral Display’ page with the ‘Probe Compensation’ button. This is shown in Figure 9.

Note: There is a similar setting for the spatial scan; in this case turning ON compensation helps visually delineate better the source and path of the pre-defined peak signals from the background noise.

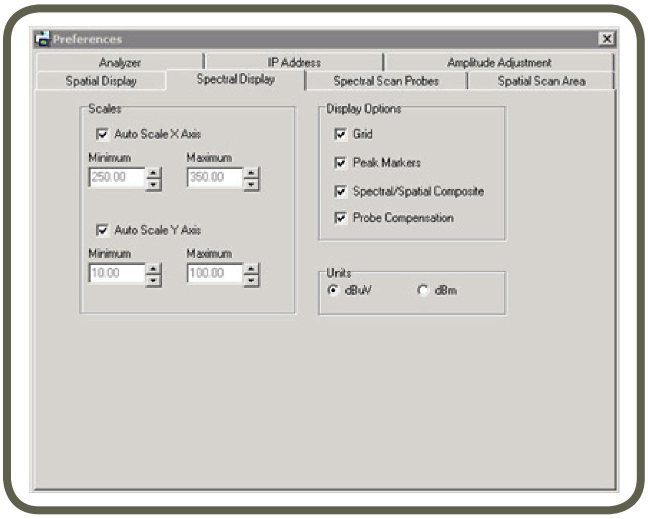

Figure 9 - Application of Compensation on Preferences Settings

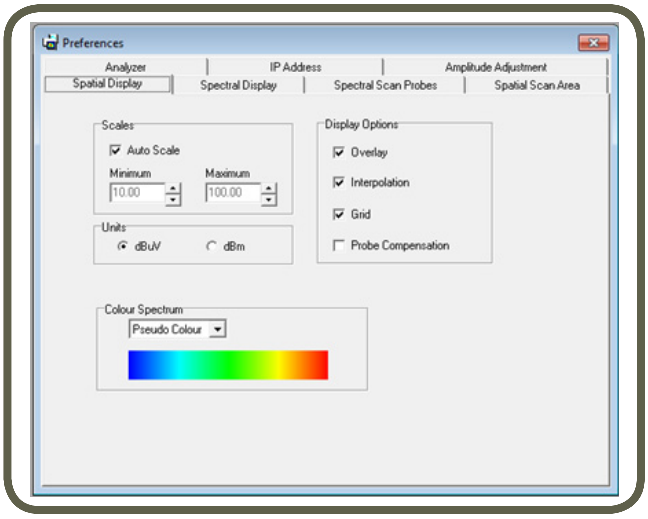

Figure 10 - Application of Compensation on Preferences Settings