Don’t Let EMI/EMC Compliance Certification Slow You Down

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Uncover Problems Early with Pre-compliance Testing

EMI regulations are in place throughout the world to provide improved reliability and safety for users of electrical and electronic equipment. Compliance testing is exhaustive and time consuming, and a failure in EMI at this stage of product development can cause expensive re-design and product introduction delays. In addition, the full compliance test in a certificated lab can be expensive, with costs ranging from $1,000 to $3,000 per day.

Pre-compliance testing is commonly used to catch compliance problems early and improve the probability of a successful first pass of full EMI compliance testing. Today, cost effective test solutions can easily be setup to quickly reduce your time-to-market. This white paper discusses what you will need to setup your own pre-compliance testing capability and useful tools for troubleshooting problems that you may uncover.

"Failing compliance testing can mean design turns that will delay the final product release"

"Pre-compliance testing doesn't have to be expensive."

Setting Up for Precompliance Testing

Pre-compliance testing is not required to conform to international standards; the goal is to uncover potential problems and reduce risk of failure at the expensive compliance test stage. The equipment used can be noncompliant and have lower accuracy and dynamic range than compliant receivers if sufficient margin is applied to the test results.

With the introduction of the Tektronix RSA306B USB based Real Time Spectrum Analyzer, pre-compliance testing has never been easier or more cost effective. Test setups using the RSA306B and similar low cost products are used to perform both radiated and conducted emission measurements that can help you minimize both your expense and schedule for getting your products EMI certified. [1]

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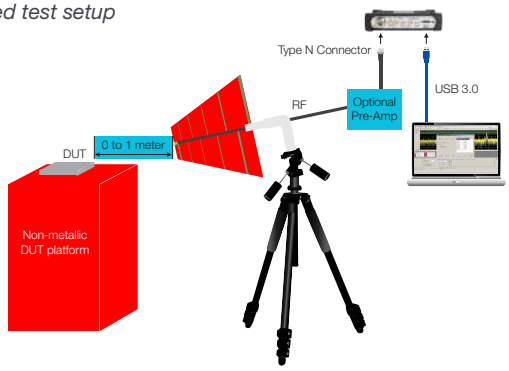
(a) Radiated test setup



(b) Conducted test setup

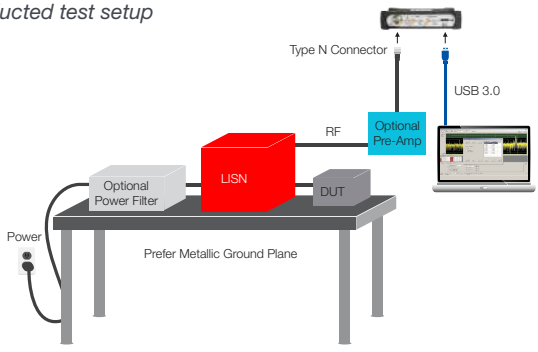
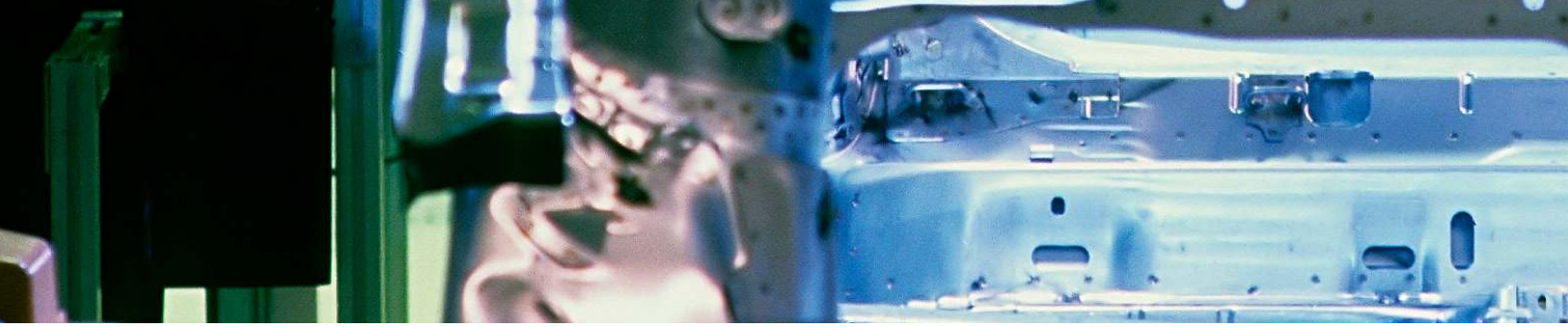


Figure 1. *With the Tektronix RSA306B USB based Real Time Spectrum Analyzer pre-compliance testing has never been easier or more cost effective.*



"Use the same test setup but focus only on the frequencies defined by the WiFi, Bluetooth, etc. specs."

Becoming an Intentional Radiator

The race to add products to the Internet of Things brings a degree of complexity to EMI testing. Not only do product manufacturers need to learn how to properly add a wireless capability to their product, but from an EMI perspective it requires additional intentional radiator testing.

An intentional radiator is a device that broadcasts radio energy (not infrared or ultrasonic energy) to perform its function. These devices intentionally use the radio spectrum and therefore always require FCC or other equivalent equipment authorization. Devices that are intentional radiators are also subject to unintentional testing requirements. Emissions at frequencies other than those the device is designed to use can occur because of internal circuitry.

The test setup for an intentional radiator is the same as the radiated emissions setup shown in Figure 1a. However, in this case, the frequencies of interest are limited to the radiated frequencies and frequency masks defined by the specifications, such as WiFi, Bluetooth, etc.

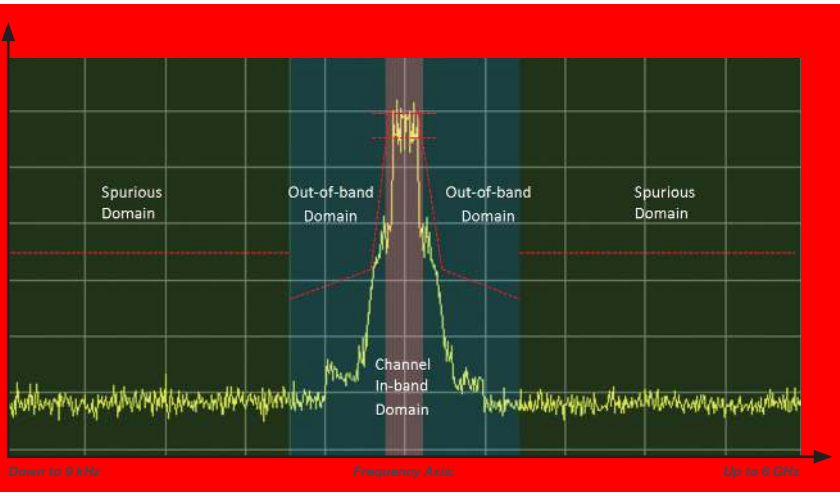
For pre-compliance testing, the frequency domain is divided to 3 sub-domains (zones). Each has its individual regulation, and the wireless device integrators should be successful in "the 3 step spectrum pre-compliance test" before taking your products to a compliance lab. [2]

Figure 2. *The compliance of intentional radiators is divided into three sub-domains or zones.*

Step 1 In-band (Channel) Domain
Check the transmit power output, the transmit bandwidth, and power spectrum density, etc.

Step 2 Out-of-Band Domain
Check the spectrum emission or the adjacent channel power ratio (ACPR). The mask is usually defined by communication standards like IEEE.

Step 3 Spurious Domain
Check the spurious emission.



Troubleshooting Your Design

When looking at any product from an EMI perspective the whole design can be considered a collection of energy sources and antennas. To identify the source of an EMI problem we have to first determine the source of energy and second find out how this energy is being radiated. Common sources of EMI problems include:

- Power Supply Filters
- Ground Impedance
- Inadequate Signal Returns
- LCD Emissions
- Component Parasitics
- Poor Cable Shielding
- Switching Power Supplies (DC/DC Converters)
- Internal Coupling Issues
- ESD In Metalized Enclosures
- Discontinuous Return Paths

"When evaluating your design, just think of it as a collection of energy sources and antennas."

—

While this list outlines some common sources of EMI it is by no means a definitive list. To identify the particular source and antenna at the heart of a particular EMI problem, we can examine the periodicity and coincidence of observed signals.

Periodicity:

- *What is the RF frequency of the signal?*
- *Is it pulsed or continuous?*
- *These signal characteristics can be monitored with a basic spectrum analyzer.*

Coincidence:

- *Are there signals generated by the DUT design that are unexpectedly showing up in your EMI results?*
- *What signal on the DUT coincides with the EMI event?*

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"Quickly discover intermittent problems with Digital Phosphor Processing (DPX)."

Finding Elusive Time Varying Signals

While the EMI standards-based methods of measurement are necessary for regulatory compliance, they frequently do not address, or even detect, the problems faced in designing for EMI in today's systems. The circa-1930's Quasi Peak (QP) detector was not intended to determine the effects of today's complex multiprocessor consumer electronics on the transient, hopping, digitally modulated and ultra-wideband signals used in modern communication and computing systems. Fortunately, measurement techniques have evolved to match these needs.

Examining the EMI signature of the DUT with Digital Phosphor Processing (DPX) is useful when trying to quickly discover intermittent problems. The DPX™ spectrum display, unique to Tektronix RTSAs, processes more than 48,000 spectrum measurements per second, and ensures that any signal lasting longer than a few 10s of microseconds is instantaneously captured and displayed. When the required span exceeds the maximum real time bandwidth, DPX can also be used in a stepped fashion. [3]

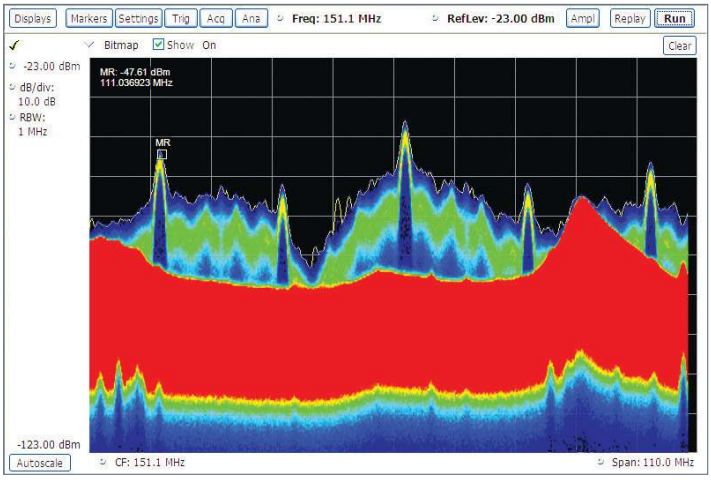


Figure 3. *Digital Phosphor Processing (DPX) may be used to quickly discover intermittent problems.*

Correlating Problem Signals Across Domains

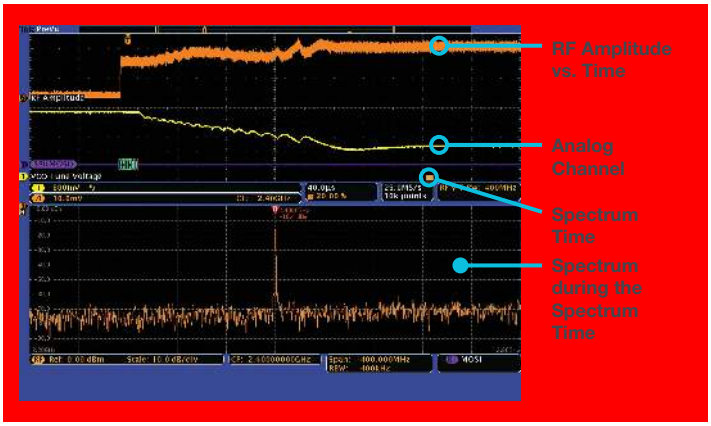
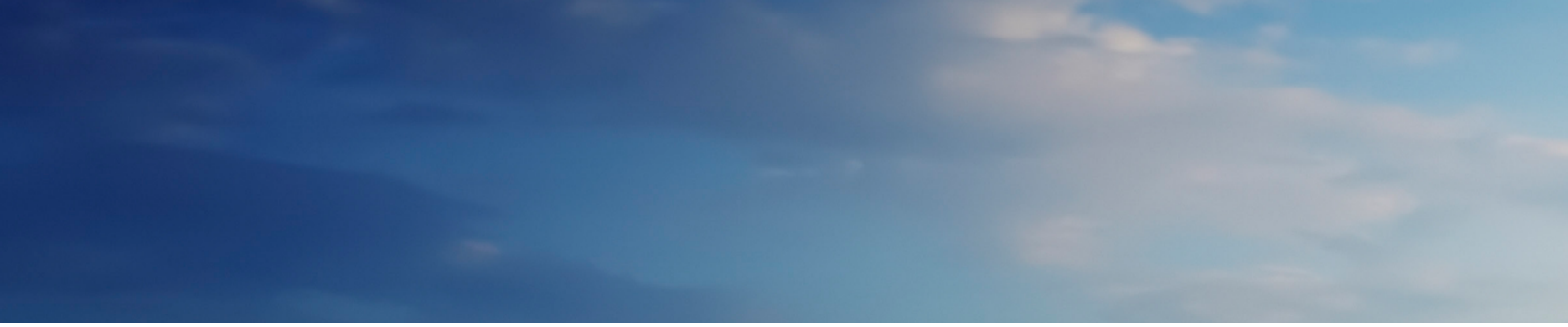


Figure 4. *Textronix's MDO4000B Series offers a unique ability to view analog signal characteristics, digital timing, bus transactions, and frequency spectra synchronized together.*

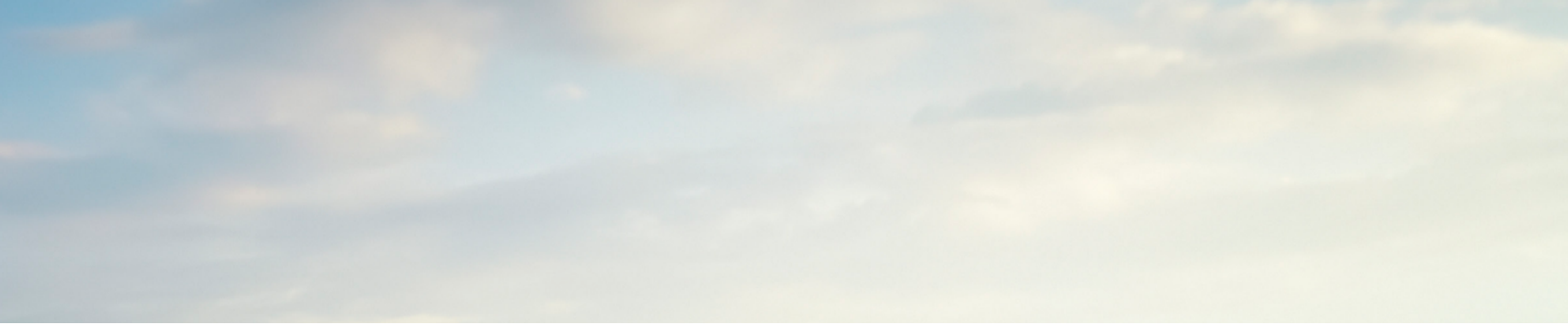
Examining the coincidence of EMI problems with electrical events is arguably the most time consuming process in EMI diagnostics. In the past it has been very difficult to correlate information from spectrum analyzers, logic analyzers and oscilloscopes in a meaningful way. The introduction of the MDO4000B Mixed Domain Oscilloscope has eliminated the difficulty of synchronizing multiple instruments for EMI troubleshooting. The MDO4000B Series offers a unique ability to view analog signal characteristics, digital timing, bus transactions, and frequency spectra synchronized together. [4] **>>**



Conclusion

Failing an EMI compliance test is expensive and can put a product development schedule at risk. However, setting up your own pre-compliance testing can help you isolate any problem areas and fix them before you go to a compliance test house. Tektronix offers the tools you need to develop a low cost pre-compliance capability that will help you minimize both your expense and schedule in getting your products EMI certified.

"Tektronix offers the tools you need to develop a low cost pre–compliance capability."



References

1. ***"Low-cost EMI Pre-compliance Testing Using a Spectrum Analyzer"***
   Application Note 37A-60141-0

2. ***"Regulatory Pre-compliance Testing for Wireless LAN Transmitter"***
   Application Note 55W-30065-2

3. ***"Real-Time Spectrum Analysis for EMI Diagnostics"***
   Application Note 37W-22084-1

4. ***"Practical EMI Troubleshooting"***
   Application Note 3GW-30828-0

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