

## EMC Pre-compliance: Testing on a budget

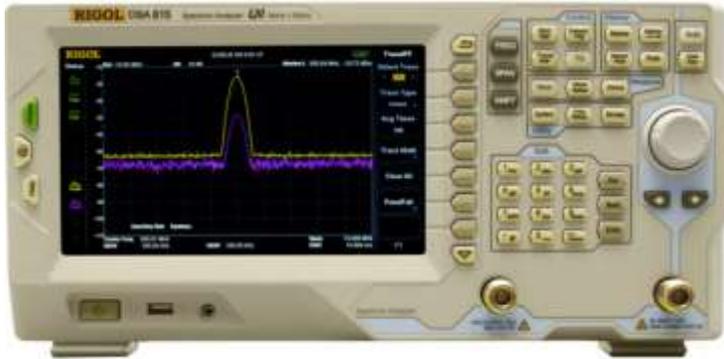


Figure 1: Rigol DSA815-TG Spectrum analyzer.



Figure 2: Near field E and H probes used to identify EMI sources

### Introduction to EMC Testing

Almost any electronic design slated for commercial use is subject to EMC (Electromagnetic Compatibility) testing. Any company intending to sell these products into a country must ensure that the product is tested versus specifications set forth by the regulatory body of that country. In the USA, the FCC specifies rules on EMC testing. CISPR and IEC test definitions are also commonly used throughout the world.

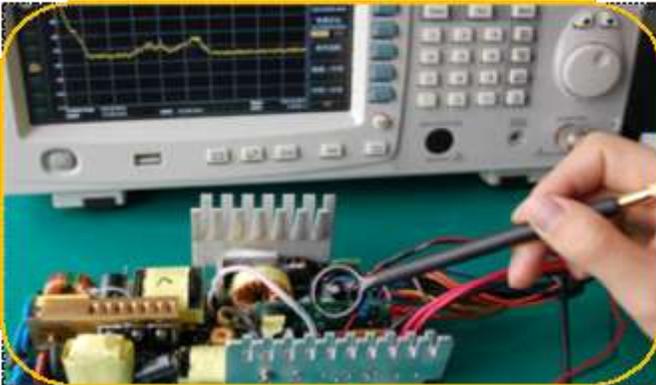
To be sold legally, a sample of the electronic product must pass a series of tests. In many cases, companies can self-certify, but they must have detailed reports of the test conditions and data. Many companies choose to have these tests performed by accredited compliance company. This full compliance testing can be very expensive with many labs charging thousands of dollars for a single day of testing. Testing a product for full compliance can also require specialized testing environments and no changes can be made during the testing. Any failures in compliance testing require that the design heads back to Engineering for analysis and possible redesign. This can cause delays in product release and an obvious increase in design costs.

One method to lower the additional costs associated with EMC compliance is to perform EMC testing throughout the design process well before sending the product off for full compliance testing. This pre-compliance testing can be very cost effective and can be tailored to closely match the conditions used for compliance testing. This will increase your confidence in passing compliance the first time through, lower your test costs, and speed your time to market.

### Measuring Radiated EMI

The most simple form of pre-compliance measurements for radiated emissions can be performed using a spectrum analyzer, like the Rigol DSA-815 (9kHz to 1.5GHz), and near field electric (E) and magnetic (H) probes as in **Figure 2**.

The most simple test is to configure the DSA to use the peak detector and set the RBW and Span for the area of interest per the regulatory requirements for your device. Then select the proper E or H probe for your design and scan over the surface of the design.



**Figure 3: Using an H field probe to test a power supply.**

Probe orientation (rotation, distance) is also important to consider. The probes act as an antenna, picking up radiated emissions from seams, openings, traces, and other elements that could be emitting RF. A thorough scan of all of the circuit elements, connectors, knobs, openings in the case, and seams is crucial. **Figure 3** shows using an H Field probe to test emitted radiation.

For the first pass, configure the spectrum analyzer to use the peak detector. This will provide you with a “worst case” reading on the radiated RF and it is the quickest path to determining the problem areas. Larger probes will give you a faster scanning rate, albeit with less spatial resolution.

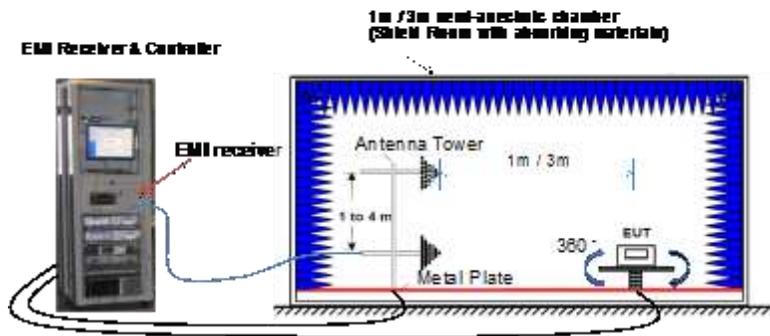
Once you have a good idea of your problem areas, you can get more detail by implementing a few common techniques. If you can, select a spectrum analyzer that has the standard configuration used in full compliance testing. This includes a Quasi-Peak detector mode, EMI filter, and Resolution Bandwidth (RBW) settings that match the full test requirements specified for your product.

This type of setup will increase testing time but should be used on the problem areas. A full compliance test utilizes these settings.. and so, your pre-compliance testing with this configuration will provide a greater degree of visibility into the EMI profile of your design.

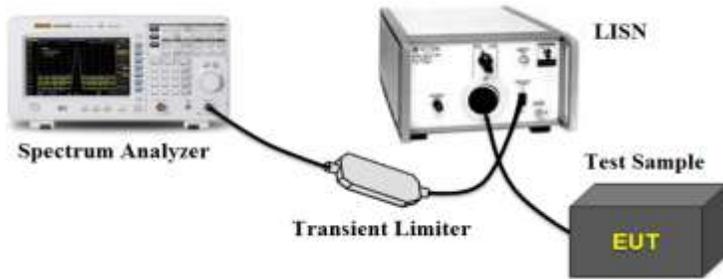
On many instruments, you can also store cable and antenna correction factors that will allow you to see the true signal, without the added errors from the setup.

The next step in radiated testing includes using antennas in place of the near field probes, a rotating platform for the equipment under test (EUT), and can include a special room that minimizes environmental factors (semi-anechoic). These setups are beyond the scope of this document, but there are references at the end that provide good references for the details of the setup. **Figure 4** shows a typical radiated compliance setup.

## Radiated Emission Measurement System



**Figure 4: A typical compliance setup for emissions testing.**



**Figure 5: A typical compliance setup for conducted emissions pre-compliance testing.**



**Figure 6: A Rigol DSG3060 RF Source.**

## Measuring Conducted EMI

Conducted EMI testing requires analyzing the RF energy that is coupled from the instrument or test circuit to the main power line it is connected to.

Like Radiated EMI, Conducted EMI is also measured using a spectrum analyzer, but it also requires a transient limiter and a Linear Impedance Stabilization Network (LISN). A LISN isolates the power mains from the equipment under test, isolates any noise generated by the EUT, and couples the signals generated by the EUT to the spectrum analyzer.

As with emissions testing, the best start is a scan over the frequency range of interest using the peak detector on the spectrum analyzer. Then, perform a Quasi-Peak scan using time while maintaining a high degree of confidence in your test.

## Immunity testing

Emissions testing requires measuring a device's radiated or conducted output. In some cases, such as CE testing for Europe, requires immunity testing. This includes delivering a known amount of RF power to the device-under-test using antennas and probes. The device must function under certain RF power levels at specific frequency spans.

For RF immunity pre-compliance, you can use an RF source like the Rigol DSG3000 RF Source in conjunction with E field probes and antennas to test sensitive areas of your design.

## Options

To obtain data that more accurately represents the compliant performance of your product, you can also use analyzers with a Quasi-Peak detector and EMI filter. This is available with the RIGOL EMI options (EMI-DSA800). Software like the RIGOL S1210 EMI Test Software, can help with test sequencing, limit line/corrections, and report generation for pre-compliance testing.

## Unprecedented Value

EMC Compliance testing is mandatory for the majority of electronic products that are slated for sale throughout the world. For the cost of 1 day of compliance testing, you can have a pre-compliance setup that you can use to continually monitor and improve your design. This will help speed product development and save the company money.

## Reference Material

### International Regulations:

[FCC Sub Part 15](#)

[International Electrotechnical Commission \(IEC\)](#)

### Practical EMC testing series:

[www.compliance-club.com/pdf/EMCTestingPart1.pdf](http://www.compliance-club.com/pdf/EMCTestingPart1.pdf)

[www.compliance-club.com/pdf/EMCTestingPart2.pdf](http://www.compliance-club.com/pdf/EMCTestingPart2.pdf)

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