## Troubleshooting Radiated and Conducted Immunity Problems in Your Development Lab

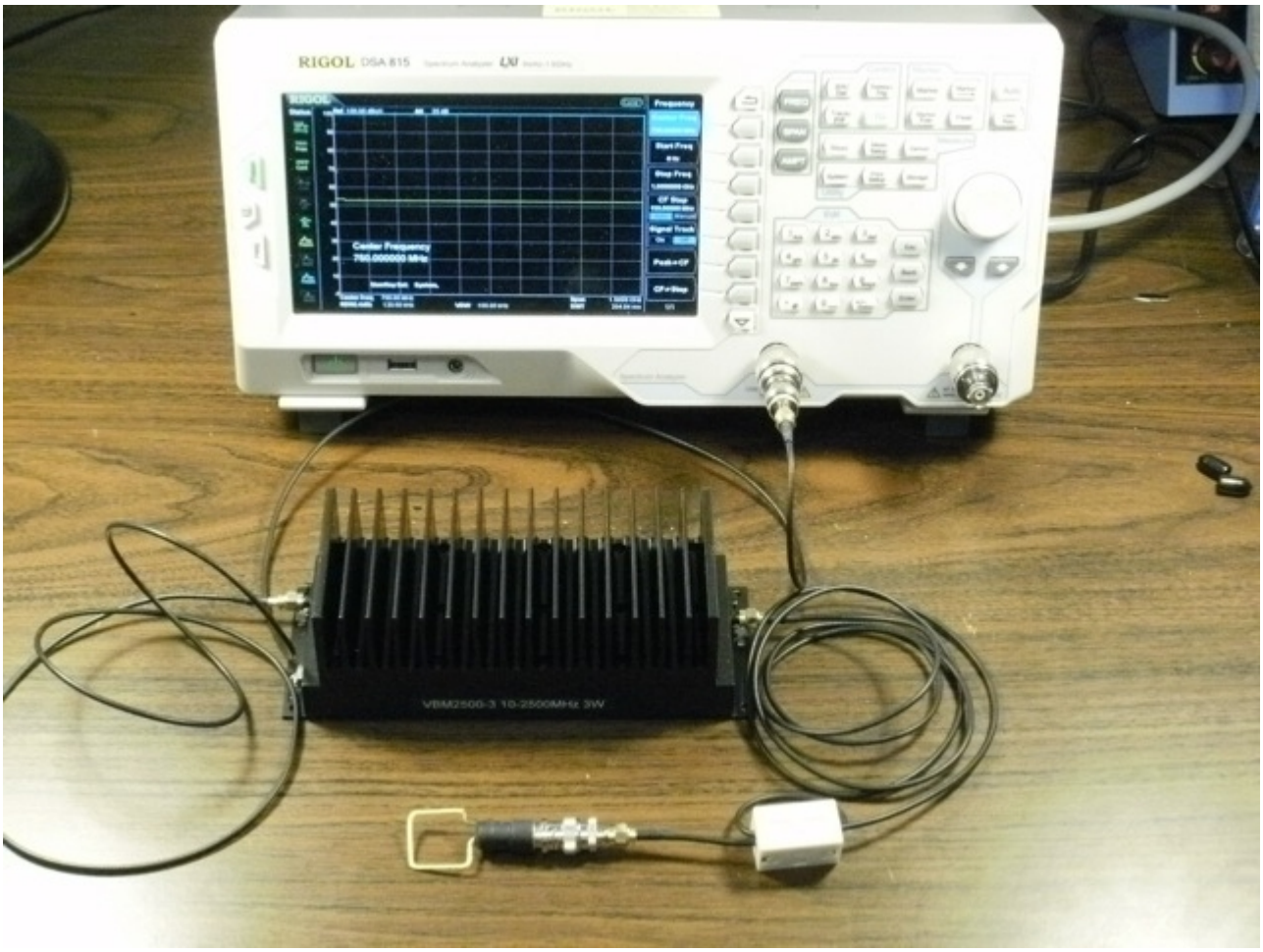


**Figure 1.** Test Setup for Troubleshooting Radiated and Conducted Immunity Problems

**Abstract:** Tackling radiated and conducted immunity problems can be difficult because of the high cost of the equipment and chamber normally used to perform these tests. An inexpensive test bench setup that can effectively find radiated and conducted immunity problems is presented.

Finding and fixing radiated immunity problems can be difficult because the chambers and associated equipment are expensive and generally not available in the design lab. Figure 1 shows a test setup that is useful for debugging radiated and conducted immunity issues right on the design bench. Shown in the picture are a Vectawave VBM2500-3 three Watt RF amplifier, a Rigol DSA815 spectrum analyzer (used for its tracking generator in this test), and a homemade square one inch loop driven by the VBM2500-3 Amplifier.

With this equipment, an engineer can find locations in equipment that respond to RF signals in an unwanted way. For an RF output of about one Watt, voltages and currents can be induced in equipment that are comparable to that of a 100 V/m RF field (lots of assumptions here), but just locally near the side of the loop held nearest the circuit.

To see the kind of signals that can be produced, Figure 2 shows the overall test setup including an Agilent DSO5054A oscilloscope and a homemade circuit board with a path crossing a 5 cm ground

plane break (a no-no in board design). The path runs from a BNC connector to a 47 Ohm load resistor to terminate the approximately 50 Ohm path. The BNC connector on the board is connected to the channel one input on the scope.

The tracking generator in the spectrum analyzer is set to 400 MHz and is driving the input of the amplifier at a level of about -7 dBm. The amplifier has a gain of about 38 dB so the power output (if into a 50 Ohm load) is about 31 dBm, a little over a Watt.

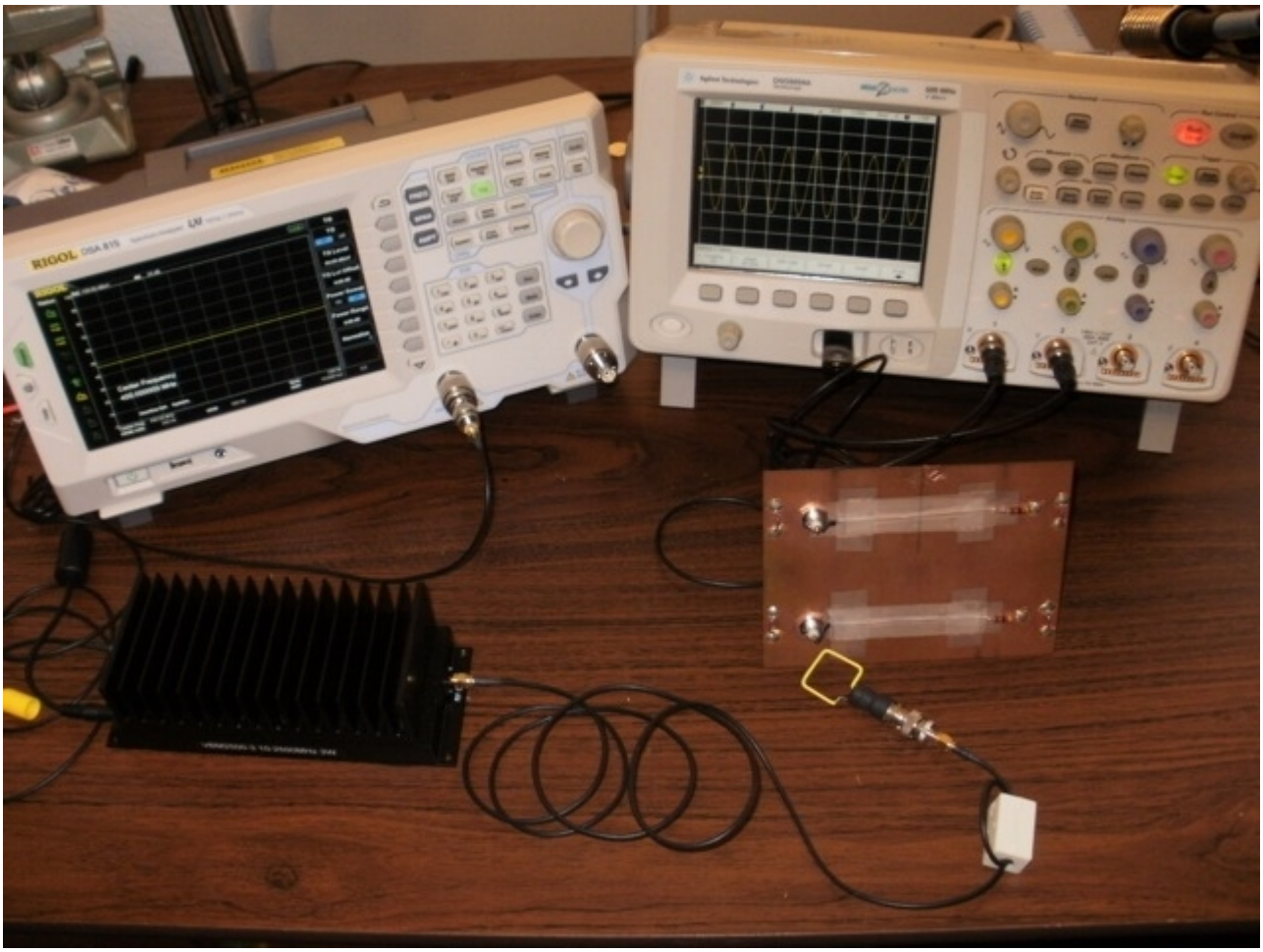


**Figure 2.** Test Setup to Investigate RF Induction into a PCB with a Ground Plane Break

In Figure 3, the square wire loop (fancy term: magnetic field probe) is being held up to the path crossing the ground plane break and the resulting plot on the oscilloscope can be seen. Figure 4 shows the scope trace in detail.

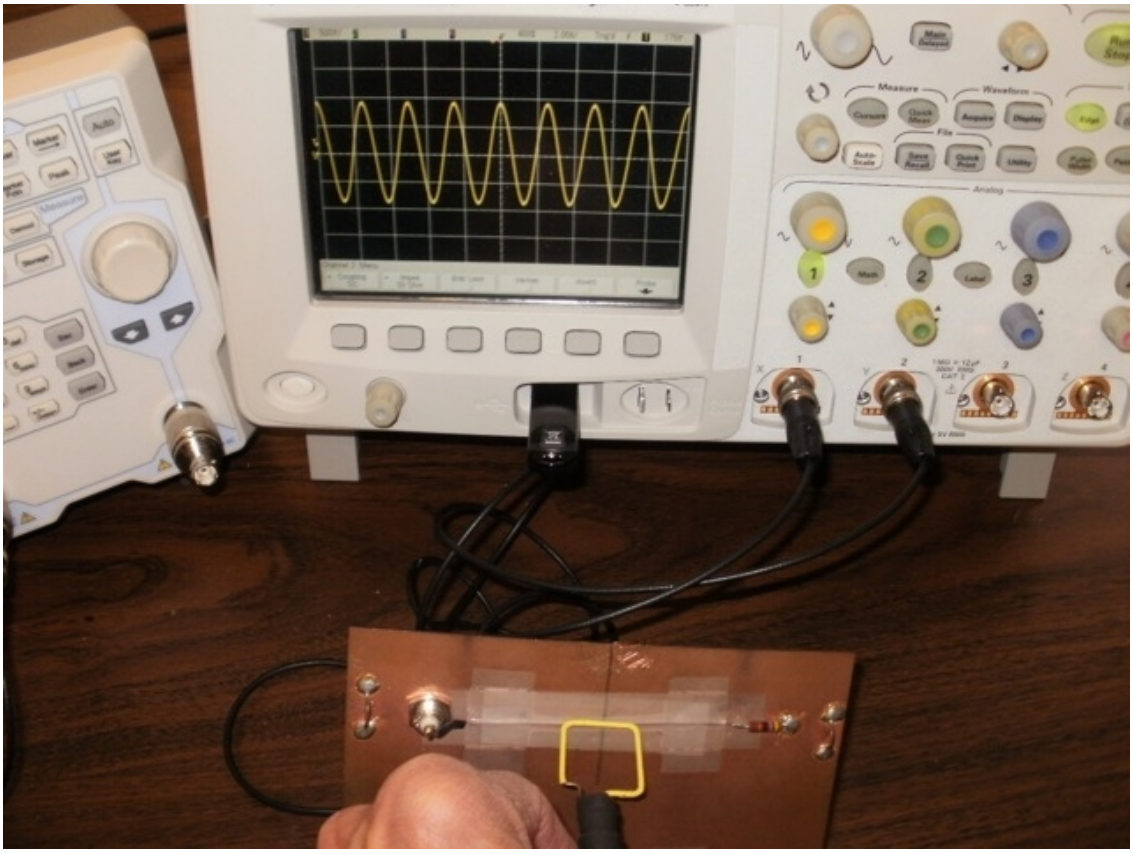

**Figure 3.** RF Signal Injection Into Path on the Test Board

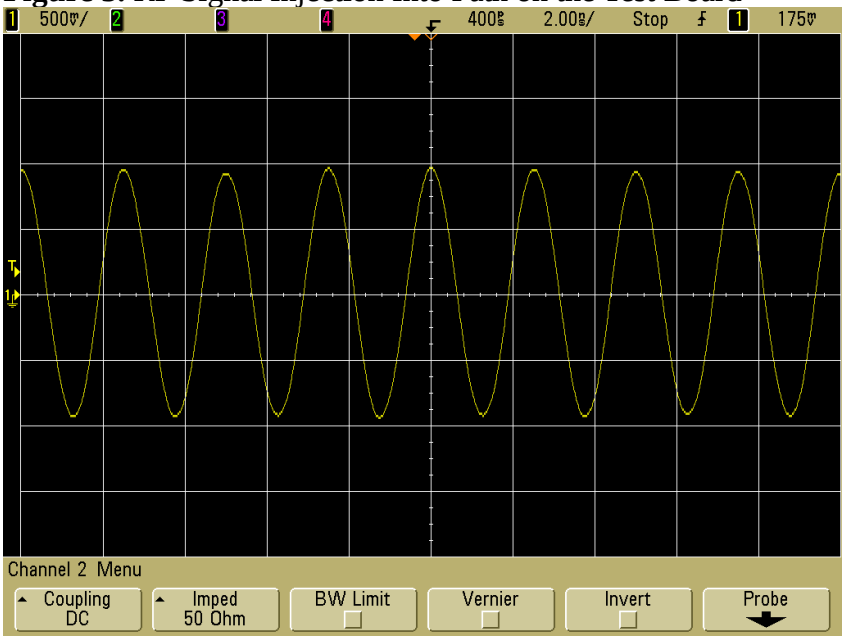


**Figure 4.** Resulting Signal Injected Into the Signal Path

In Figure 4, we can see that about one Volt peak of RF at 400 MHz was induced in the path for an output from the amplifier of about 31 dBm, a little over one Watt. A lot of that power is reflected back to the amplifier from the loop, but enough is injected into the circuit to simulate the effect a significant external RF field.

This method can be used to inject energy into electrical resonances in a system and other circuits as well, to find parts of a system that might be the cause of a radiated immunity problem. This method can also be used to find problem areas in a system experiencing conducted immunity problems as well.

**Summary:** Using an inexpensive RF source, a small power amplifier, and loop probe, an engineer can find sensitive parts of a system that could cause a radiated or conducted immunity problem. Using this method of generating local fields, troubleshooting a piece of equipment can be done right on the development table, a much more convenient place to work than an EMC test lab.
Vectawave VBM2500-3 RF Amplifier

Rigol DSA 815 | 1.5 GHz Spectrum Analyzer

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