From March 2010 *High Frequency Electronics*
Copyright © 2010 Summit Technical Media, LLC

DESIGN NOTES

Notes on Shop-Made Test Accessories

From time-to-time, some piece of the test system is required, but is not on hand. Often, a quick shop-made device is sufficient to get the test done immediately, without waiting for delivery from a supplier. When the test parameters are not critical, these devices can save time and allow the project to move forward. A few of the circuits that might be needed are:

- Bias Tee / DC Block
- Non-standard value attenuator
- Impedance matching attenuator
- RF termination
- Mismatch termination
- RF diode detector
- RF termination with sample output
- Gain block amplifier
- Simple filters

Here are a few suggestions that can make it easier to build circuits like these with acceptable performance in a company laboratory.

Microstrip Breadboard

Perhaps the most common method of creating a one-off circuit is a small piece of microwave laminate, with a microstrip line that has been etched, milled, or carved with a hobby knife. SMA connectors are readily attached at the input and output, and surface mount active and passive components are installed to perform the desired function.

Many manufacturers' evaluation boards are simple enough to fill this need. Figure 1 is a photo of two such boards from Freescale Semiconductor, part of an evaluation kit for their general purpose amplifier RFICs. They can be used as intended for a handy fixed-gain amplifier module, or the board may be suitable for the installation of other components in a different circuit.

Point-to-Point Assembly on a Ground Plane

The unetched, solid surface of a printed circuit board provides a high quality ground plane suitable for circuits into the GHz range. Components may then be soldered directly to one another, or connected with very short interconnecting wires. Most test accessories are very simple circuits, and the added inductance of a few short connections can be tolerated when 5% or 10% accuracy is sufficient. It is important to use components appropriate for the frequency range, and to make the assembly as compact as possible for minimal stray reactance and coupling.

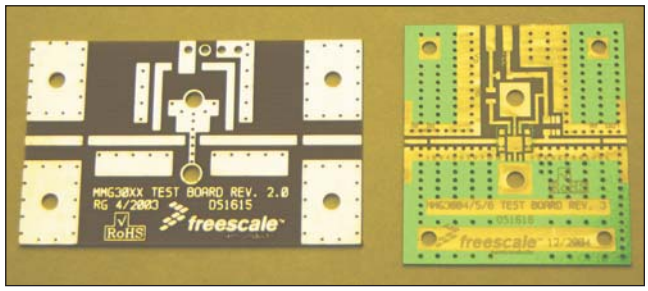

Figure 1 · Component manufacturers' evaluation boards can provide an appropriate substrate for a lab-built circuit.

A Few Construction Hints

Layout and assembly requires good high frequency techniques: short interconnections, small impedance variations and good connector-to-board attachment. Shielding may be required for some circuits, although a low-profile circuit close to a good ground plane will suffice in most cases.

Selection of components may be even more important than good layout. Of particular note are resistors, which can vary greatly in their series inductance. Devices using bulk resistance are usually best, although carbon or metal film resistors can perform well—but only if they are not trimmed in manner that increases inductance, such as a spiral laser cut. Capacitors are easier to choose, because manufacturers almost always provide ESR versus frequency data. Inductors also have performance data available, but the range of values and Q vary significantly among different products.

Finally, all DC power connections must be adequately filtered/bypassed to avoid EMI problems.

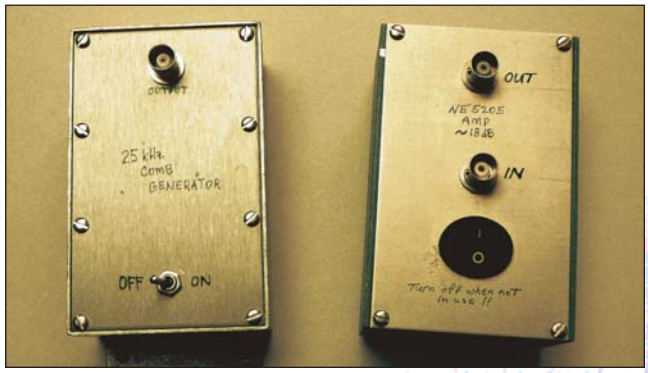

Figure 2 · Accessories that will be used repeatedly can be installed in connectorized enclosures, such as this comb generator signal source (left) and 0-500 MHz broadband amplifier (right).