There Is More to Power Sensors Than Cal Factors

By Michael L. Schwartz

As most of you already know, RF power sensors require periodic calibration. Power sensors are usually calibrated once a year by either your company's in-house calibration lab or by sending them to a reputable third party calibration lab. But that doesn't mean your power sensors are working properly, because many of these labs just test the power sensor's frequency response and assign a new set of cal factors. For many power sensors, their applications and end users, that is just not enough to maintaining the accuracy and reliability of RF power measurements. So we want to help educate technicians, engineers and quality managers on what is required for power sensor calibration.

Reflection / rho Tests

This test checks the power sensor's ability to consume the RF power that is applied to it; power that is not consumed by the power sensor is reflected back to the source. Because there is no adjustment for reflection, power sensors that fail reflection usually have to be repaired. The most common problem is the input connector's pin depth, or a bad electrical connection between the input pin and detector circuits inside of the sensor. Testing a sensor's reflection is an important test, because a broken, damaged or intermittent power sensor reflecting too much power could potentially cause damage to the signal source or amplifier.

Agilent E-Series Sensors

When Agilent Technologies (then Hewlett Packard) introduced their E-Series power sensors, they added a Linearity Test to the calibration procedure. These new power sensors were revolutionary, because they could measure RF power from -70 to +20 dBm. Plus, they stored all of their cal factors in the EEPROM.

What most people don't know is the E-Series power sensors store more than just cal factors in their EEPROM. They also store linearity data that has to be updated to make accurate RF power measurements. Many labs are skipping this test because they did not realize the importance of this test or they do not have software capable of testing linearity and updating the EEPROM.

What Is Linearity?

The linearity test checks the power sensor's ability to accurately measure power outside of the diode's square law region. When the sensor is measuring lower power levels, the power sensor's diode detector is operating inside of it's square law region. As long as the power sensor's diode remains within its square law region, the power meter can accurately measure the RF power, because diodes voltage to power applied remains linear. Once the diode is outside of the square-law region, the voltage to power applied no longer remains linear or predictable. So the power meter is no longer able to accurately measure the RF power applied to the power

sensor. To overcome this problem, Agilent added a linearity table to the EEPROM. The linearity table contains correction data used to correct power measurements when the power sensor is operating outside of the square-law region. This is what gives the E-Series sensors their 90+ dB of dynamic range.

Why Test Linearity?

Over time, as the power sensor is used, over powered, warmed up, and cooled down, the characteristics of the diode change and the linearity table has to be updated. We were surprised to find that after 2 years of use, more than 20% of the sensors we tested failed to pass the linearity tests. Once we adjusted the sensor, by uploading the new linearity correction data, it was able to perform within specification.

What software tests Linearity?

Currently Cal Lab Solutions is the only third party software solution that is able to test rho, cal factors and linearity. We offer several custom packages and configurations with PS-Cal. We can upgrade your HP 11760A power sensor calibration system, Tegam's System II, as well as offer several turn-key solutions to get your lab up and running with complete 17025 compliant uncertainty budgets.

For more information or to request an online demo, contact Cal Lab Solutions at 303.317.6670, or E-mail Sales@CalLabSolution.com