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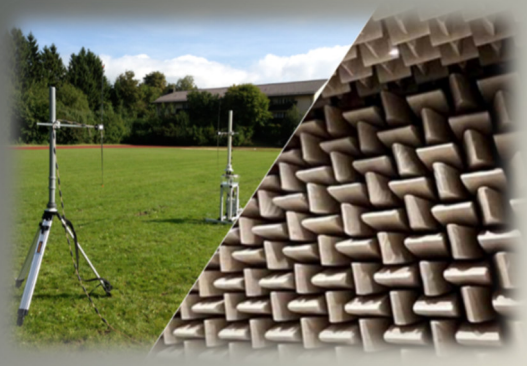
Antenna Measurement Low-Cost Equipment



Challenge

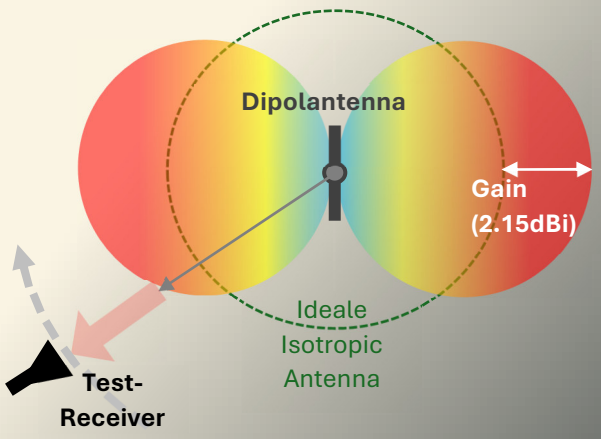
Measuring antenna performance is often seen as a process requiring costly equipment and complex setups. But achieving accurate results doesn't always have to be expensive or complicated. In this article, we'll show you how to effectively measure your antenna's efficiency and gain using simple free-field measurements, all with your own device—no need for expensive anechoic chambers or specialized tools.

Why Antenna Testing is Essential

A powerful antenna is crucial for a stable wireless connection. Poor antennas can lead to weak signals, reduced range, and even dropped connections. Thorough antenna performance testing helps assess the quality of your antennas and identify potential weaknesses.

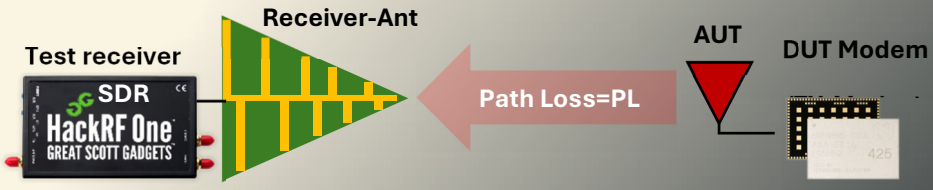
Antenna Basics: Efficiency and Gain

Before testing antenna performance, it's important to understand efficiency and gain. Efficiency indicates how much input power P_conducted is converted into radiated power P_radiated. Mismatches cause energy loss, with P_radiated < P_conducted. Higher antenna efficiency means less energy loss. Antenna gain shows how effectively the antenna directs radiated energy compared to an isotropic radiator. Proper impedance matching is key to avoiding power loss, and the test receiver must be at a fixed distance from the antenna under test (AUT).testing helps assess the quality of your antennas and identify potential weaknesses.



Using the DUT Modem as Test Equipment

One of the most cost-effective approaches to measuring antenna performance is using your own Device Under Test (DUT), especially for wireless technologies like WiFi, where the DUT modem can act as both transmitter and receiver. In these cases, you can use the DUT modem to send and receive signals, allowing you to analyze antenna efficiency by measuring signal strength. In cellular applications, the DUT modem can also be used for measurements, though only in either transmit or receive mode. For the other side, you can use a Software Defined Radio (SDR) like the HackRF One.



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This device offers an affordable alternative to expensive RF signal generators or spectrum analyzers and enables the creation of test signals that the cellular device can receive, or the reception of test signals transmitted by the cellular device. Using your own modem or an SDR makes it possible to achieve sufficiently accurate measurement results without relying on specialized and expensive equipment.

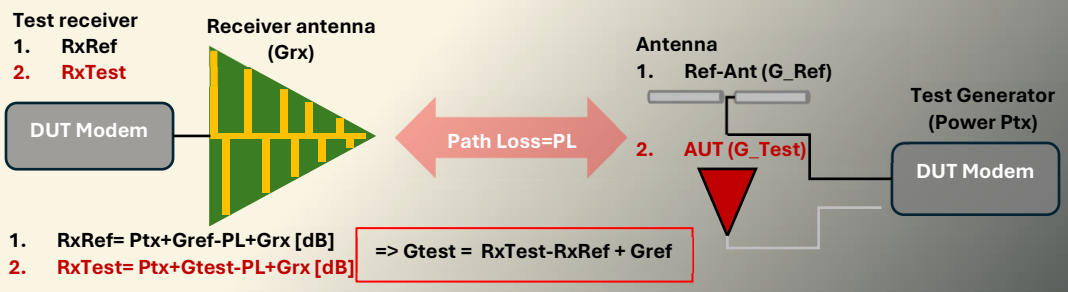
Free-Field Measurements: Alternative to Anechoic Chambers

Free-field measurements provide a realistic way to test antennas without using expensive anechoic chambers. They are performed outdoors or in open environments without reflective objects, allowing for sufficiently accurate measurements. While anechoic chambers minimize reflections and interference, they are costly. Free-field measurements, on the other hand, offer realistic conditions, are more affordable, and easier to conduct. However, weather and external interference can affect measurements.

Substitution Method: Measuring Antenna Gain

The substitution method allows you to compare the gain of a test antenna with a reference antenna. First, the signal strength is measured with the reference antenna, followed by repeating the measurement with the test antenna. By calculating the differences in received power, the antenna gain can be determined. This method only requires a reference antenna and basic measurement equipment. To ensure precise free-field measurements, it is recommended to choose an open area free from reflections and interference. Using battery-powered equipment helps avoid power line interference, and accounting for weather conditions ensures reliable results.

Aside from the reference antenna, the other items do not need to be calibrated or precise (they only need to remain stable over time).



Summary: Simplified Antenna Testing

Measuring antenna performance efficiently doesn't have to be expensive or complicated. By using your own DUT modem or an SDR for simple tests, along with free-field measurements, you can accurately and affordably determine your antenna's efficiency and gain. Need help optimizing your antenna's efficiency or want to learn more about cost-effective testing options? Quarterwave offers tailored solutions for antenna testing and performance optimization. Contact us today to unlock the full potential of your wireless systems!

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