The Many Benefits Of Testing Your Antenna

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Your customers must succeed for you to succeed. Customers expect your system or products to perform their best at all times. In this RF world, that means your antennas have to “shine”! Not only will great antennas contribute to joint vendor/customer success, they help your company rise above the competition of mediocre or even bad antenna competition.

But why do so many buyers and integrators of antennas ignore real world antenna performance? Why just hope that your vendor meets specification? Companies can buy thousands of antennas from low cost off-shore vendors, and wishfully assume that they “work”. Who does not already know that vendors often exaggerate or idealize their specifications in high competition markets? Even designs from contractors are often accepted and implemented based solely on trust, simulations, and a few return loss measurements. In our lab we see at least one antenna per week that has “great return loss”, which also suffers from poor radiation efficiency (under 10 percent). A great VSWR graph does not guarantee your antenna will radiate well!

This testing deficiency holds true on all types of antennas, from PCB mounted “chips”, SMA/U.FL fed miniatures, right through to pole mounted antennas. Most hardware and software is thoughtfully tested before sale or deployment, but why are so many antennas ignored? The risks to system functionality and your customer’s trust will hang in the balance if you skip your antenna’s verification. However, there is no reason to defer your antenna’s evaluation, help is available.

Your Antenna Test Lab Partner

An outside antenna test lab can help you arm your company with an independent evaluation. Full radiated testing over a swept frequency range is available from as little as $450 from services such as Antenna Test Lab Co.

The results of an anechoic chamber antenna evaluation will provide insight and confidence throughout your company: from design/systems engineering; purchasing; sales engineering; right through to field support; and ultimately customer success. Many companies routinely send new designs, prototypes, vendor samples, and production lot samples to an outside antenna test lab for evaluation.

A Professional Antenna Evaluation

A qualified lab can take your antenna, and measure a whole range of critical parameters like gain, radiation efficiency, VSWR (or return loss), patterns in 1D/2D/3D (polar or spherical), LHCP/RHCP gain, axial ratio, and many other performance parameters swept over your frequency bands. Go beyond your vendor’s “gain number”. Only then, can you have confidence in your wireless link. Ultimately, your antenna customers trust test results, not simulations and promises.

Your partner lab can test in a reflectionless environment called an *anechoic chamber*. With the aid of fast RF test equipment, a high speed positioner, and a selection of lab antennas, they can deliver results that are impossible from bench or roof-top testing. These days, large and successful companies have their own in-house anechoic chamber, but you don’t need one … just partner with an antenna testing service.

Services Available

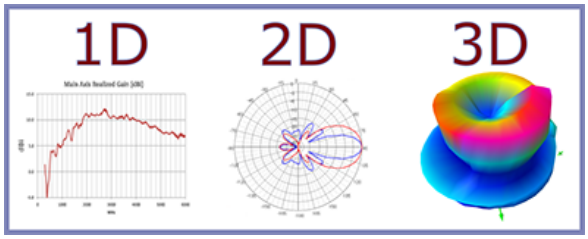
The fundamental antenna performance measurement will be *gain*. Your antenna’s gain is a measure of how much more or less it radiates compared to an ideal directionless source. The trouble is, gain is not simply one number. Gain is a function

of direction and frequency for all antennas. Instead of one gain number, each direction has it's own gain, and then they change with frequency over the operating range of the antenna. Stop thinking of gain as a single number per antenna.

Every antenna has a "pattern" or "map" of gain, which is the graphical representation of different gains in different directions. If your antenna is an "omni", you may be tricked into thinking there is a single constant gain in all directions, even if that gain varies with frequency. Nothing could be further from the truth! Even "good" omni-directional antennas have patterns with distortions and complete blind spots. And, their radiation efficiency may be good or bad as well. You can't rely on one gain number. Patterns and efficiency must be verified. Things like feed-lines and mounting brackets often trouble omni-directional antennas, and cause unexpected distortions.

Obviously directional antennas should point their radiation in a preferred direction. Your partner lab will verify how effectively this is done, along with efficiency, and information about energy going in the undesired directions. You will also know if the gain in the preferred direction is maintained across your operating frequency range.

1D Testing



These gain patterns are roughly characterized as 1D, 2D, or 3D. A one-dimensional pattern is simply the measure of an antenna's gain in a single direction. This is a bare minimum test for a directional antenna, where gain in the preferred direction is frequency swept over (and beyond) the antenna's operating bands. No "pattern" is available, since gain is not checked over a circle or sphere. Parameters such as vertical/horizontal gain, LHCP/RHCP gain, axial ratio and co/cross-polarization may be measured. This assumes your partner lab takes "vector measurements", where complex gain and phase are measured and processed into circularly polarized parameters.

2D Testing

In two dimensional testing, all of the parameters measured in 1D testing are repeated in many directions around flat circles or "cuts". Results are plotted in familiar polar format. This allows basic visualization of your antenna's true pattern. From these plots, directional antennas can have their spacial parameters calculated, such as beam width, front-to-back ratio, and front-to-rear ratio. A typical 2D polar test program in our lab may change the direction of your antenna in the test chamber every 2 degrees. This yields a single "cut" or polar plot as gain in 180 directions, with gain measured at hundreds of test frequencies. Often two orthogonal cuts are tested, for a total of 360 physical test directions for the evaluation.

3D Testing

The next logical step is not to constrain the test directions to planes and circles, but to cover the entire 3D radiation sphere. This allows true antenna pattern visualization and insights. All of the same data as 1D or 2D testing is gathered at each swept test frequency. Gain data is plotted as colored shapes known as "spheroids", which depict higher gains as warmer colors, while simultaneously illustrating higher gains as "bulges" in the plotted shape. Since these ar 3D shapes, you will need software from your test lab so that you can rotate and look at all sides of these "graphs" on your desktop PC.

A typical 3D spherical test program in our lab may change the direction of your antenna in the test chamber every 10 degrees over the surface of a sphere. Think of this as a grid of latitude and longitude coordinates, like the ones used for mapping the Earth's surface. With 10 degree resolution, the results are plotted in a "latitude/longitude" type of grid with about 700 directions. Using 5 degree "high resolution" yields about a 2,700 directions. Imagine 2,700 directions and a swept frequency range of 200 steps, that is half a million different gain measurements!

Another benefit of 3D testing, beyond it's superior visualization, is access to efficiency calculations. Because the entire radiation sphere is mapped, your test lab should calculate the numerical surface integral of the gain pattern, and provide you with radiation efficiency (in dBi average gain and in percent). You should also expect a graph of radiation efficiency vs frequency for your test program. Also, graphs of gain (in any desired direction) vs frequency can be made, just as they are in 1D testing.

Learn More

An antenna will ultimately cripple or enhance a wireless product's success, so why leave it all to chance? Expert antenna testing services are easily available, cost effective and timely. Your antenna test service should will work hard to give you the insight you need for a successful RF product. You don't have to let your lack of a test chamber force you to trust vendors or simulation. Antenna testing is a task easily handed off to a specialized antenna testing laboratory.

Our engineers evaluate a wide variety of antennas daily. Antenna Test Laboratory Co can evaluate your antenna within days, and provide full performance data, as well as boost your understanding and confidence. Full evaluations are available from only $450.

About the Author

Glenn Robb is a Founder and Principal Engineer at Antenna Test Lab Co. www.AntennaTestLab.com

Glenn is an EE who has been working professionally with antennas for 30 years. He has a passion for testing antennas and providing customer insights. Day to day, he runs the anechoic chamber at Antenna Test Lab Co and is responsible for hundreds of customer antenna evaluations. Glenn also designed all of the lab's custom software and test hardware configurations for accuracy, speed, and cost-effectiveness.

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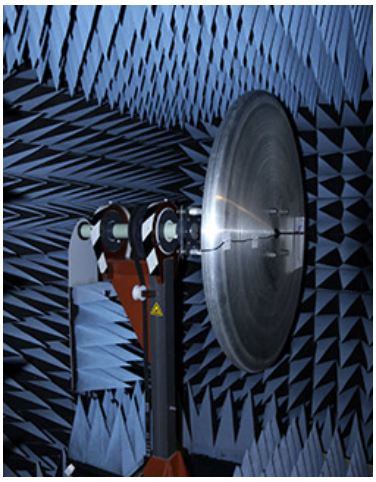

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