

The Radio Hotel- Antenna Efficiency

By Rick Hiller -- W5RH

Pete, KD5QPX, and I were enjoying lunch at What-a-Burger while discussing various topics. One topic being his new copy of EZNEC 6.0 recently supplied by Ol' Saint Nick. Pete had been using another modeling program, but they went out of business. He needed an alternate modeling application and I had suggested EZNEC. At lunch, Pete asked the long time EZNEC user, me, where EZNEC displays the modeled Antenna Efficiency. I responded that EZNEC does not display it as a simple value. He then proceeded to show me that his older modeling program shows you a discrete "Calculated Antenna Efficiency" value. Nice capability. EZNEC does it a bit differently, but first.....

What is Antenna Efficiency? To plagiarize from the EZNEC User Manual—"Antenna Efficiency is defined as the fraction of the applied power which is radiated. The remainder of the applied power is lost as heat in lossy parts of the antenna structure. System efficiency can also include the effect of ground, feedline, and matching network loss." Our desire is to have all of the power put into the antenna system to be radiated. If any power is lost due to heat or coupling with the surrounding environment, you want that power loss to be minimal.

Efficiency is simply Power Radiated versus Power Not Radiated. Power Radiated is what is actually launched into free space and Power Not Radiated is that power lost due to the antenna wire resistance (heat), lost thru a counterpoise or the ground itself used for a verticals return currents (actual earth or a car body if mobile) and other environmental type losses like coupling to your house siding, etc. From a practical standpoint, do everything you can to reduce the amount of Power Not Radiated, thus improving the efficiency. Use quality antenna wire, use the appropriate coax for your power level and frequency, use good quality insulators, ensure good connections on the TL/coax to the antenna and, lastly, locate your antenna as much in the clear, away from surrounding objects, as you are able. If you are using a vertical, the ground/counterpoise side of the antenna system is VERY important. Maximize your wire on the ground. Recent studies point to "on ground" (or even elevated) insulated wire radials being the preferred deployment. A poor vertical ground system reduces the antenna efficiency, thus reducing the strength of the radiated field, but, note, not the shape of the far field antenna system generated pattern.

You can measure antenna efficiency, albeit difficult, and one of the current ways to measure it is with a Wheeler Cap. However, doing so at 7 MHz, or any HF frequency would be a task. Why? Google: Wheeler Cap to read about it. "Antenna under Glass" might be a layman's description. So it might be best to stick with the modeling estimates.

Back to EZNEC: the way to model for efficiency within EZNEC is in 5 steps: 1) set all of the loss type parameters to zero (i.e. wire loss, ground type, etc.); 2) run the model calculation and see the results on the 2D pattern/gain plot. Then, 3) set all the loss parameters to their normal lossy settings; 4) run the model calculation again; and, finally, 5) compare the 2D pattern/gain results of this second run with the first run. Note the dB difference of the radiation pattern maximum gain between the two runs. This will give you a reasonable indication of efficiency. RF Café has a chart noting dB loss versus efficiency – go to:

<http://www.rfcafe.com/references/radio-craft/decibel-level-gain-may-1936-radio-craft.htm>

Another way to look at efficiency within EZNEC is to note the Average Gain Figure, but I will leave you to research that on your own, as it requires a further understanding of the use of EZNEC, which requires much more room to explain than I have been allocated by Sr. Editor--IZO. A full explanation of both of these methods of efficiency modeling can be found in the EZNEC manual, available on line.

GL ES 73 DE W5RH Enjoy your hobby.

Next time.... Antennas, et cetera; in QST Magazine

*The purpose of **The Radio Hotel** is to give you a practical kick start into exploring the workings of antenna systems. It is a series, so go back and read the previous columns to get the whole picture, as one month relies on the previous month's information. Google the buzz words and find out what they mean. Read up on antenna system theory to see how it all works together. You will be glad you did.*