Letters to the Editor

An Analysis of Stress in Guy-Wire Systems (Mar/Apr 2006)

Doug,

On page 42 of my article, the pressure on a round cross-section is defined as $P = 0.0025\ V^2$. I shouldn't have stated that *FW* = Area × Pressure × Coefficient of Drag = *WW* × *RD* × *P* × *Cd*, since the coefficient of drag (0.0025) is already incorporated into the pressure value. In fact, that is true wherever the pressure appears in an equation. The attendant computer program is correct.

In an equation on page 43, one character was omitted. The equation is $dT = y \times dF = y \times P \times dA$ = lever arm × pressure × width × *y* (the last term should be *dy* rather than *y*). I missed that on the proof copy.

— 73, Bill Rynone, Ph.D., P.E., PO Box 4445, Annapolis, MD, 21403

RF Power Amplifier Output Impedance Revisited (Jan/Feb 2005; *Letters*, Mar/Apr 2006)

Hello Doug,

This letter is in response to your challenge to the readers of Letters to the Editor in the March/April issue of *QEX*, and to the two contributors in that issue debating the topic of RF power amplifier output impedance for solid-state PAs, that certain assertions previously advanced on these pages remain unchallenged, and that further experiments are needed. I would like to remind you that an overwhelming series of experiments to convince readers that when a PA tuned for maximum power output, and operating within the design recommendations by the manufacturer of the tubes used, is indeed conjugately matched to its load.[1] My response refers to your comments on the load variation method to measure the output impedance of a power amplifier, refuted by Warren Bruene, W5OLY, "Letters to the Editor", Jan/Feb 2001 *QEX*, pp 59-61.

I do not intend to rebut that letter. My purpose is to convince you that Mr. Bruene is wrong, based on experiments previously reported.

Tom Rauch, W8JI, (a co-author of the referenced paper) improved the test procedure devised by W5OLY, which is involved with feeding a small reverse generator signal back into an operating amplifier via a high-power attenuator, and measuring the reverse generator's voltage level along a 50-ohm transmission line. This test once again agreed with the results I obtained using the test setup identical to Mr. Bruene's, but the new test's ability to determine the direction of change resulted in conclusions very much contrary to Bruene's earlier measurements.

Mr. Rauch's measurements revealed that, for some 14 amplifiers of widely varying types, maximum efficiency could be obtained by tuning the output network while solely observing the reverse mismatch change! As the tank network was adjusted to present a 50-Ω load to the reverse power generator (reverse generator voltage equal at every point along the 50-Ω line), maximum efficiency and output power was obtained. As a matter of record, Rauch noted it was much more difficult to obtain optimum efficiency using the meters on the amplifier and the power output indicator than it was by watching the mismatch for the reverse power generator (RPG).

Amplifier output impedance (referenced to the output terminals of the PA) is certainly non-dissipative; power generated is available for transfer. Assuming a low-loss transmission line, the impedance of the transmission line is a non-dissipative impedance. The antenna itself has a measured (or calculated) input impedance, which for efficient antennas is a non-dissipative impedance. Power is not absorbed by the resistive component of this impedance, power input to the antenna is transferred to the propagation medium. Finally, since the input impedance of antenna systems measured at the input to the transmission line feeding the antenna is generally not a resistive impedance equal to 50 Ω, an antenna system tuning unit (ASTU) is used, the purpose of which is to provide a conjugate at the output terminals of the ASTU, and hence a conjugate match referenced to the input terminals (the transmitter side of the ASTU).

— John S. (Jack) Belrose, VE2CV, ARRL Technical Advisor, **john.belrose@crc.ca**

Hi Jack,

Thanks for your letter. We had to shorten it a bit so we could focus on two fundamental assertions you mention that appear to us to be mutually incompatible.

You've consistently stated that maximum power transfer occurs when a conjugate match is achieved. Yet, you indicate that under the conditions you claim to constitute such a match, no power is dissipated at the tube end of a network from the reverse power injected during the Bruene experiment (non-dissipative resistance), even though Mr. Rauch measures the s22 of the amplifier to be 50 + *j*0 Ω.

In that case, you imply on the one hand that *no* power transfer is occurring from load to source and on the other, that no reflections occur anywhere. We just don't see how you can have it both ways.

Were amplifier output impedance completely non-dissipative, you would not measure an s22 of 50 + *j*0 Ω. You would instead measure a pure reactance. If you say that the s22 isn't the same as the amplifier output impedance, then you don't have a conjugate match by definition.

— Doug Smith, KF6DX, QEX *Editor,* **kf6dx@arrl.org**

In Search of New Receiver Performance Paradigms (*Empirical Outlook*, May/June 2006)

Dear Doug:

Your plaints concerning measured IMD shortcomings are well understood if not widely recognized. More specifically:

The voltage gain of nonlinear, black-box components (such as receivers, transmitters, A/D converters, etc) can be expanded in a power series when input level does not cause significant change in component operating point. For typical low-distortion components, that power series can often be truncated, retaining terms only up to the third order. Straightforward trigonometric expansions of two-tone response then yield the often useful concepts of second- and third-order "intercept points." These points permit a rapid estimation of useful black-box dynamic range. It is quite easy to show that these estimates are seriously in error when:

1) More than two sinusoids are applied to the input (complex waveforms, multiple interferers, etc).

2) Truncated terms above third order are significant (such as A/D converters, class-C transmitters, etc).

3) Black-box operating point is a function of input level.

In those instances, detailed and often messy calculations are required, based upon both the actual voltage-gain function and the phase relationships among the multiple input sinsusoids. I know of no simple ways of overcoming these inherent drawbacks to the use of IMD in characterizing black-box performance.

— Neal Eddy, **fneddy@charter.net**

Hi Neal,

Thanks for your comments. My main point, of course, was that we continue to report figures that don't comply with the defining equation. Something has to give.

— Doug Smith, KF6DX, QEX *Editor,* **kf6dx@arrl.org**

[1] J. S. Belrose, W. Maxwell and C. T. Rauch, "Source Impedance of HF Tuned Power Amplifiers and the Conjugate Match," Fall 1997 *Communications Quarterly*, pp 25 - 40.

Measuring Height With a Poor Man's Gizmo (*Tech Notes*, May/June 2006)

Doug:

Last week, I mused (honestly!) about the many times I have heard hams state the heights of their antennas. All of them apparently used the elusive "eyeball algorithm" to establish their measurements. I've never heard anyone say that the height was *measured* with an instrument of known accuracy.

Kudos to William Rynone and *QEX* for the "Poor Man's Gizmo." Print and sell a bunch of reprints and publicize the gizmo in *QST* and on the ARRL Web site. Finally, reflect on the wisdom of Henry St. John (1716): "Truth lies within a little and certain compass, but error is immense."

— 73 de Jim Olsen, Jr, W3KMM, **w3kmn@aol.com**

Uniform Current Loop Radiators (May/June 2006)

Editor,

NP4B has written an interesting article. What a novel idea to segment a piece of twinlead like this — very clever. I don't think the theoretical explanation is correct though.

First, the sinusoidal distribution of current along a conventional wire antenna is not due to wire inductance as the article says. It is due to propagation delay, and reflection from the ends of the wire in the case of a dipole. The current distribution is a standing wave along the antenna, caused by the interaction of forward and reverse waves. That is covered in *The ARRL Antenna Book* and elsewhere.

Also, the model for the segmented line shown in Figure 2B doesn't seem to be correct. It appears that the inductors represent the alternating wire segments and the capacitors represent the overlap between the segments. The overlap is almost the entire portion of the line, however, and not only is there capacitance in this region but the wires are magnetically coupled, too. For the entire overlap, in fact, the structure remains the original transmission line with its original distributed capacitive and inductive coupling between the wires.

I think the model for the segmented line is more complex than the author has indicated. The results are interesting and obviously the antenna works, but I don't think the explanation is correct.

— Gerrit Barrere, KJ7KV, **gerrit@exality.com**

Dear Doug,

I accept the criticism of KJ7KV on my simplistic explanation as due to wire inductance alone. The model of Figure 2B is a lumped model of a distributed system. The complete distributed system has been modeled on *EZNEC* as in Figure 1 of this letter. Note the (essentially) triangular distribution of current on each wire segment; summing the current in adjacent wires yields a net uniform current, as proposed and realized.

While KJ7KV is technically correct in that the wire segments are also magnetically coupled, this coupling is lower than the electrical coupling by a factor of μ_0 (approximately) and may be ignored.

I look forward to further discussion in *QEX* regarding this antenna.

By the way, my article contained an error in Figure 9, the SWR plot. The vertical scale should be corrected to run from 1.0 to 6.0.

Also, several readers wrote to ask how the feed line is connected and where. Figure 2 in this letter shows how a resonant section is split in two to accept the feed line.

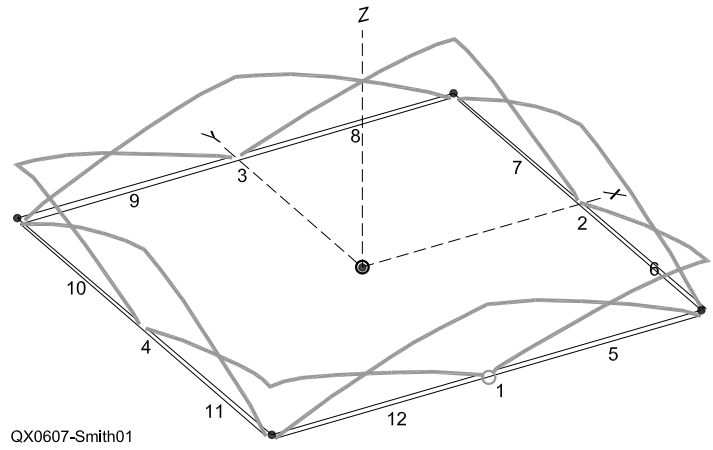

Figure 1 — Detailed *EZNEC* modeling of the uniform current loop antenna with closely spaced overlapping wire segments. For ease of modeling, eight sections are used in this model. The driving source is in the center (current maximum) of element #1.

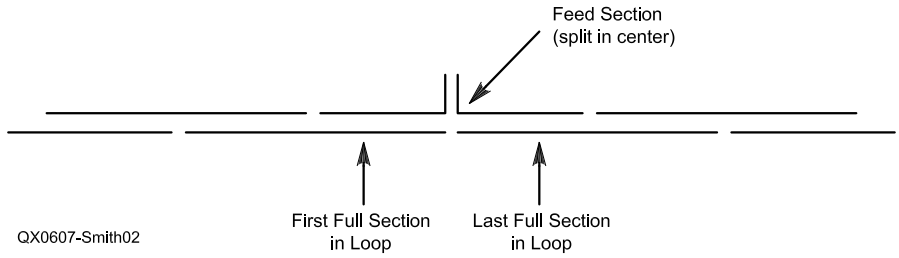

Figure 2 — This diagram shows how a resonant section of the loop is split in the center to accept the feed line.

— 73, Bob Zimmerman, NP4B, **zimmo2@juno.com**

Dual Directional Wattmeters (May/June 2006)

Doug:

There were a few minor errors in my DDW article, and I would like to issue a correction or clarification in an upcoming issue.

In Figure 6B the wattmeter readings should have been 43.5 W and 143.5 W for P_{REF} and P_{FWRD}, and in Figure 6C they should read 5.5 W and 105.5 W.

In Figures A1, A2, and A3, I used an alternate notation for the forward and reverse voltage with V+ used for V_{FWD} and V– for V_{REV}.

— 73, Eric von Valtier, K8LV, **EVonvaltie@aol.com**