

A New Generation of Balanced Antenna Tuners

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Paul Danzer's article¹ in the April 2004 issue of *QST* brought to paper a concern many of us have had for some time—the use of baluns at the output of antenna tuners. As noted in his article, if the balanced load is near the balun's design impedance (typically 200 Ω for the usual 4:1 balun) all is well. Unfortunately, the typical random sized centered antenna with random length ladder line feed has an impedance at the feed point that varies dramatically with frequency. The result can be heating and loss (and occasional damage) at the balun. These effects were well documented in a series of *QST* articles by Frank Witt² and later in a performance evaluation of unbalanced tuners with both balanced and unbalanced loads.³

So How Do We Fix the Problem?

As Danzer noted, the classic solution has been the use of an inherently balanced tuner. The commercially manufactured E.F. Johnson Matchbox tuners of the '50s worked reasonably well in their day, and over the bands that they covered (we didn't have the 60, 30, 17 and 12 meter bands back then). Now at least three manufacturers have begun offering balanced antenna tuners of a different configuration. For this review we selected the MFJ-974H and the Palstar AT1500BAL and AT4K. Interestingly, each of the three uses a different architecture, and each is different from the design of the old Matchbox! In addition to those units, SGC has announced a low power self-contained auto-tuner, the SG-211, which shares the design concept of the AT4K and will be the subject of an upcoming Short Takes column. We thought it would be good to evaluate the performance of the medium and high-power units and provide a comparison to the old Johnson tuner.

¹P. Danzer, N1II, "Open Wire Feed Line—A Second Look," *QST*, Apr 2004, pp 34-36.

²F. Witt, AI1H, "How to Evaluate Your Antenna Tuner—Parts 1 and 2," *QST*, Apr 1995, pp 30-34 and May 1995, pp 33-37.

³R. Lindquist, N1RL, "Product Review—*QST* Compares: Four High-Power Antenna Tuners," *QST*, Mar 1997, pp 73-77.



Bottom Line

A new breed of antenna tuner available in different flavors from multiple manufacturers addresses concerns about using baluns with high SWR to feed balanced antenna systems.



From the top the MFJ-974H, the Palstar AT1500BAL and AT4K. On the right, they are being scrutinized by their logical ancestor, the Johnson Matchbox.

What's in the New Tuners?

Glad you asked! As noted, each of the tuners uses a different design configuration. Each can be directly compared to some of the common unbalanced configurations. Note that the power ratings and price of the Palstar tuners put them in a different category from the MFJ units and thus, direct comparisons may not be appropriate. Both the MFJ and the Palstar AT1500BAL are fully balanced tuners—the MFJ a dual T section design with

shunt L, and the Palstar a dual L section with shunt C. The Palstar AT4K tuner takes a completely different approach. It uses the insulated unbalanced scheme suggested in Paul's article and described in detail in *The ARRL Antenna Book*.⁴ The

⁴*The ARRL Antenna Book*, 20th edition, Chapter 25, pp 15-18, Available from the ARRL Bookstore for \$39.95 plus \$8 shipping in the US, \$10 elsewhere. Order number 9043. Telephone toll-free in the US 888-277-5289, or 860-594-0355; www.arrl.org/shop; pubsales@arrl.org.

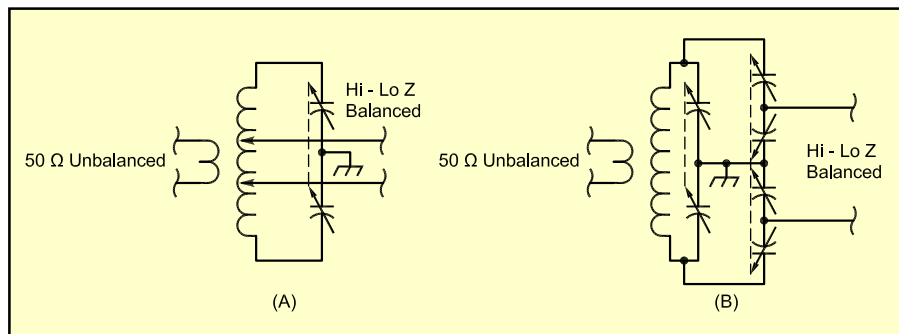


Figure 1—At A, the traditional balanced antenna tuner. At B, the Johnson Matchbox antenna tuner. Simplified view without bandswitching.

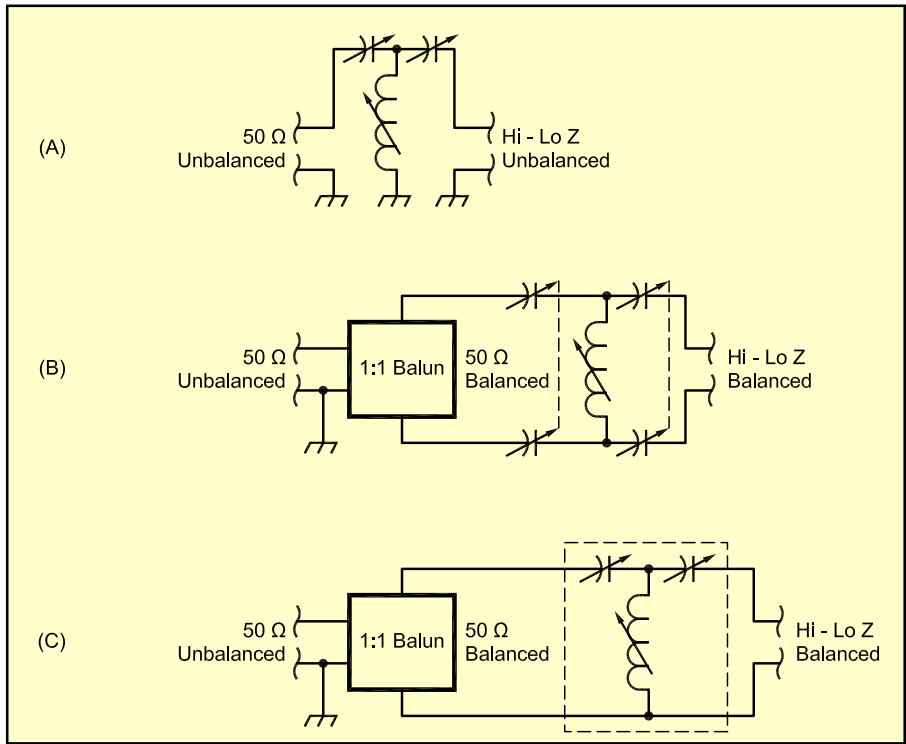


Figure 2—At A, an unbalanced T-network tuner. At B, a balanced T-network tuner. At C, an unbalanced T-network tuner for balanced loads.

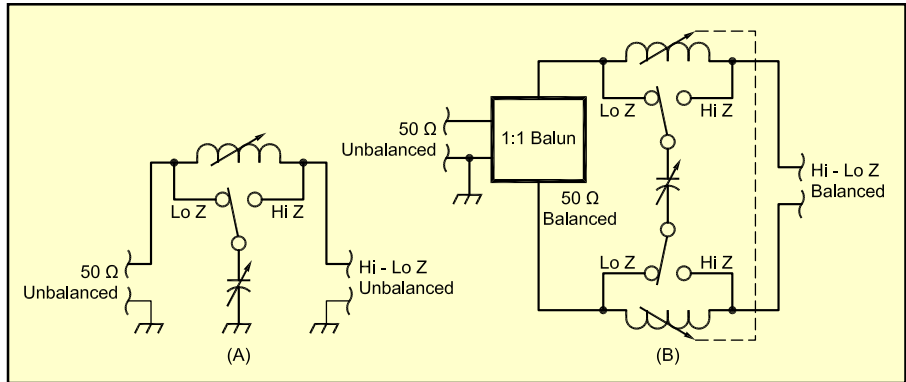


Figure 3—At A, an unbalanced L-network tuner with switched capacitor. At B, a balanced L-network tuner with switched capacitor.

relationship of the designs to their more commonly encountered unbalanced configurations are shown in simplified schematics in Figures 1 through 3.

The other differences between the units are in their ratings. The MFJ tuner covers 160 through 6 meters, while the Palstar tuners top out at 10 meters. Both Palstar tuners are rated at 1500 W or

greater (the AT4K has a reduced rating below a 25 Ω load) while the MFJ tuner is rated at 300 W PEP, 150 W CW. The ratings of the Johnson Matchboxes were established in a day when amateur power levels were specified based on average dc power input, rather than the current PEP RF output power. A “275 W” Johnson

matchbox was thus rated to work with transmitters running 275 W dc input, or about 200 W average output. This was in the day of plate modulated AM service, so that rating further translates to 800 W PEP under today’s rules. Similarly, a “kW Matchbox” would likely be rated today as a 3 kW PEP tuner.