RF Transmission Lines and Antennas

Part Five

Overview:

This week we are going to review antenna resonance and how it and size relates to efficiency. Previous discussions are available on the PPRAA website under Tech Talk.

I. Antenna Resonance and alternate antenna styles

1. **Antenna resonance is needed to assure an impedance match between parts of your antenna system. This in turn assures efficient transfer of RF energy from the transceiver to your antenna and ultimately radiated. This equally true for receiving by your transceiver.**
2. **Antenna tuners, baluns and other matching devices can assure an impedance match if the antenna is not operated at resonance. However, these add expense and have limited usefulness when operated under multiband conditions and add complexities for the untrained operator.**
3. **For 50 plus or minus years antenna makers have searched for ways to over come these limitations and to make antennas that appeal to our need for multiband and physically small antennas.**
4. **A dummy load is a large resistor that is usually 50 ohms resistance when measured with a simple digital multimeter. We can easily connect our transceiver to a dummy load and achieve that important matching of impedance's that we have talked about previously. Our transceiver is happy, the transmission line is happy, but we will not be happy. Most everyone recognizes that a dummy load is not a good antenna device. It does not transmit nor receive very well at all. This is due to it's resistance is almost the total impedance seem by the transmission line.**
5. **What happens when we move that dummy load outside and place it high and in the clear like a wire antenna. Guess what; it transmits and receives a little better that when it was setting under the table in our shack. Depending on a lot of variables it may function a few db's better. So you go from pure noise at S1-2 to a S2-3 db level. Not very impressive is it? Yet our transceiver is very happy…it is still operating into a 50 ohm load. But little is getting out or in.**
6. **Now what happens when we put up an antenna designed for 40 meters and operate it on 20 meters? The SWR will be 6-8:1 and it's performance will be very poor.**
7. **Now suppose we add a resistance across the two sides of the feedline. If we choose the resistance value carefully the impedance to the transmission line will be near the 50 ohm for coax or the impedance of the balanced line and the transmission system will experience harmony. More power will be delivered to the antenna so the RF radiation level should be improved. However, the radiating elements of the antenna are unchanged and the added resistance is still dissipating some RF energy as heat. Thus the radiated energy has not been improved.**
8. **In some instances these types of antennas are perfectly acceptable. Operating and propagation conditions may be such that it is not necessary to be concerned about weak signal levels. These antennas have a place in transmitting and**

receiving. Their use should be evaluated again their pro’s and con’s before purchase.

9. Has it occurred to your that antennas are usually much larger than the radios that are used with them. We have stressed that antennas should be operated at resonance yet they are much larger than the radio producing the RF frequency they are radiating or receiving.
10. Yes, in simple terms, the radio has a resonant circuit inside that produces the radiated RF energy. This leads us to the conclusion that our antenna can be much smaller that it is to produce resonance.
11. In the early days of radio, resonance was achieved by the use of a capacitor and inductor inside the radio. The capacitor was made of small metal plates that were placed very near each other and were usually variable by turning and attached knob. The inductors were made of wire coiled on a paper or metal form. Today resonance is achieved slightly different but radio size is still smaller than our antenna.
12. What happens when we take the capacitor and inductor just described and placed them high and in the clear and hook them to our transmission line? Instance impedance match of course. How about the radiation efficiency?
13. It would be very low because even though we are efficiently transferring RF energy due to their resonance the radiation efficiency of the resonant parts is very low. This lowered radiation efficiency is caused by several factors.
    a. Ground losses are usually greater in this type antenna as in practical installations they tend to be closer to ground or grounded objects.
    b. Resistance of their smaller wires adds more resistance causing more power to be lost in resistance.
    c. Smaller components in general have lower radiation efficiency. There is simply less surface area to radiate RF energy and their resistance tends to be higher lowering their radiation efficiency.

II. Summary

1. As we have seen simply presenting the correct impedance from our antenna device to our transmission line and subsequently to our transceiver is imply not enough to assure efficient radiation of RF energy.
2. A full sized balanced antenna mounted high and in the clear is the most efficient antenna. However, marketing schemes, operational needs and other factors influence antenna efficiencies, shapes and sizes.
3. Antenna choices should consider all factors involved. Not just the most efficient radiator.
4. Next week we are going to look at loop antennas. These are a form of balanced antennas but have many different considerations.