RF Transmission Lines and Antennas

Part Four

Overview:

This week we continue our discussion of transmission lines and antennas. Previous discussions are available on the PPRAA website under Tech Talk. This week we are going discuss RF in the shack. This discussion will center on balanced and unbalanced antennas.

I. RF in the Shack

1. **Does your microphone bite you when you transmit. Does your autotuner erratically tune. Does your rig randomly transmit when using your computer. Does other strange things occur in your shack. RF in the shack may well be the problem. RF in the shack is accompanied by feedline radiation. RF in the shack can also affect the resonant frequency of the antenna. Usually the resonant frequency is lowered as more mass is added to the tuned circuit of the antenna. Another side affect is lowered antenna sensitivity.**
2. **The primary reason is an unbalanced antenna system. Remember your antenna system is composed of the antenna itself, transmission line and transceiver. Your ground system may also be included in some instances. This is not to say that coax which is by nature unbalanced cannot be used. Coax is fine provided it is installed correctly.**
3. **Several things can cause an unbalanced antenna system.**
    a. **The antenna itself may be built unbalanced. For a dipole type antenna to radiate it must have two electrically isolated parts. Dipole antennas include what we frequently call a dipole plus antennas such as a yagi, j-pole and ground plane. Windom and vertical antennas are other examples.**
    b. **What causes these to be unbalanced. Some are actually built unbalanced to solve various design problems the main being to achieve an SWR as low as possible or to achieve a gain. An antenna is unbalanced when it has more physical mass on one side of the insulator than another. How can a simple wire dipole fit this. Remember the inner conductor of coax is attached to one side of the dipole and the outer shield is connected to the other. The inner coax conductor cannot radiate since it is inside the shield thus it is not part of the antenna. However, the shield of the coax is on the outside and if one side of the dipole is connected directly to the shield it becomes part of the antenna and can radiate RF and pass RF down the outside of the coax back into the shack.**
    c. **The best way to eliminate RF in the shack in this instance is to use a balun between the antenna and coax as we discussed before. Another important benefit of a balun is that by selecting the right balun the SWR can be controlled as we discussed in part two.**
    d. **However, some antenna designers building unbalanced antennas expect there to be some RF on the outside of the coax shield. When determining resonant frequency of their antenna they take this into consideration. They typically expect this RF to be scrubbed off the coax by laying it on the ground or thru other means before it enters the shack.**

Adding a balun in this instance does not control the SWR and will change the resonant frequency of the antenna.

e. **As implied earlier another reason antennas maybe unbalanced is thru amateurs connecting coax directly to the antenna or balanced feedline without a balun.**

4. **RF radiation from an unbalanced antenna system.**
    a. **RF radiation from a simple dipole high and in the clear and operated at resonance is in the pattern of a donut with the wire going thru the hole in the center. Other words, the strongest energy is radiated from the sides and perpendicular to the antenna. Little energy is radiated from the ends of the antenna.**
    b. **When an antenna is unbalanced and especially when operated at nonresonance the radiation pattern is distorted. The feedline will radiate and will combine with the radiation from the antenna and will cause adding and subtraction of energy from that radiated from the antenna. The resulting pattern may have four or more lobes and or radiate at different angles from the dipole or feedline. Frequency, height above ground, size of the antenna and several other factors will influence the radiation pattern.**
5. **Benefits of unbalanced antennas.**
    a. **Marketing dictates that a particular manufacture of antennas have a distinctive style of antenna. In several cases visual appearance when translated into an antenna design results in an unbalanced antenna. From that point engineers choose one or more of several methods to make the antenna resonant and usually prescribe an acceptable method to keep RF off the shield of the coax and ultimately out of the shack. Therefore, marketing has found a way to gain product recognition at the expense of having an unbalanced antenna.**
    b. **Another major benefit of an unbalanced antenna is to achieve a more appropriate impedance to assure acceptable impedance match among the components of the antenna system. Off center feed antennas are a good example. Again, engineers or amateur radio operators must find ways to eliminate the unwanted RF in the shack.**
    c. **Some antennas such as a j-pole actually have an improved radiation pattern causing apparent gain in radiated power. This is done by compressing the earlier mentioned donut pattern to have more energy radiated near parallel to the ground as less radiated upward at an angle to the ground. It is important to remember that when we say an antenna has gain it is not actually increasing the power delivered to it by the feedline. The gain is obtained by changing the radiation pattern to concentrate energy in a particular direction. A yagi antenna is a good example. Energy is radiated toward the small end of the antenna and away from the larger end.**
6. **Unbalanced antenna cautions.**
    a. **When planning an antenna purchase determine if it is unbalanced. Some vertical antennas have their insulator at or near their bottom and claim to not need radials or counterpoise. In these instances the outside of the coax will become the other half of the antenna. This can result in RF in the shack, distorted radiation pattern and low sensitivity. Coax shield usually is not a good radiator or receiver of RF radiation.**

b. **Short verticals that claim to be multiband and are about 30 feet or less tall may have all of their resonant parts on one side of the center insulator resulting in RF on the coax and in the shack. Know how that RF is going to be removed.**
c. **Determine how off center feed wire antenna manufactures are going to remove the RF from the coax and ultimately from your shack.**

Next week we are going to review antenna resonance and how it and size relates to efficiency. Stay tuned.