RF Transmission Lines and Antennas

Part Six

Overview:

In the past five weeks we have looked at transmission lines and antennas. This part will conclude that topic. We are going to be looking at loop antennas in this last part.

I. Loop antennas are a type of balanced antenna.

1. **There are two basic types of loop antenna.**
   a. **A small loop antenna in it's simplest form is not resonant and is usually less than one tenth of a wavelength long. These antennas are usually used for receiving only. Portable radios, and direction finders are two of the uses for this type antenna. They may be either wound a ferrite rod core or with an air core. Portable radios are a prime user of ferrite rod core loop antennas. The core concentrates the magnetic field of received RF energy thereby giving some apparent gain and the expense of being somewhat directional. As loop antennas have inductive impedance a capacitor can be used with them to add capacitive impedance thereby producing a form of resonance which in turn increases the apparent gain of the antenna as well as giving some ability to choose the loop antenna's operating frequency.**
   b. **A well know manufacture of amateur products has market a form of small loop antenna used for both receiving and transmitting. It has been fitted with an automatic variable capacitor that tunes the loop as the received and transmitted frequency changes. There have been reports that it's operation may be difficult to master.**
   c. **Large loop antennas are intended to be resonant. They are usually one half or one wave length long. Usually one side is a quarter wavelength long. However, it should be stressed that loop antennas can be almost any shape as long as the loop is completed. The important thing to remember is that it must be a half or full wavelength long around it's circumference.**

2. **Large loop antennas are most frequently used in amateur radio for transmitting and receiving purposes as opposed to just receiving. Remember, generally if it transmits well it will receive equally well. (The reverse is less true. This is the reason small loop antennas are usually not used for transmitting.)**
   a. **Large Loop Antennas usually can be oriented vertically or horizontally.**
   b. **Vertical loops are usually feed at one of the lower corners. This is done to assure an impedance match to the feedline and to use the corner support as a support for the feedline. A 4:1 balun would be in order if feed with coax and a 1:1 should be considered if feed with ladderline. Or, no balun at all when feed with ladderline. The radiation pattern of a vertical loop is broadside to the vertical side of the antenna. You may remember this is similar to a dipole antenna.**
   c. **Remember when choosing transmission line that ladder line has much less loss per foot than coax and is balanced as your antenna should be. However, due to lack of shielding it's routing is more difficult than coax.**
   d. **At first glance it would seem that horizontally oriented loop antennas would radiate well toward the ground and vertically from the antenna. However,**

ground reflections cause a omnidirectional pattern that has a takeoff angle at 20-30 degrees. This is opposed to the two sided pattern from a vertically oriented loop antenna.

   e. "Takeoff angle" is simply the angle above the local horizon that the RF energy leaves the antenna. The lower the angle the better for long distance communications. Twelve to fifteen degrees or lower is about ideal for long distance communications between continents. Higher angles like 20-30 degrees are more usable for shorter distances such as Colorado to New York.

3. **A specialized form of loop antenna is the "Quad" antenna.**
   a. These have a radiating element and a reflector element similar to a yagi antenna. When used on 6 meters and higher frequencies they frequently have a director element as well.
   b. The appear to be three dimensional where as a yagi appears to be two dimensional. That is a quad antenna has height, width and length whereas a yagi antenna only had width and length. Quads tend to be large than yagi's for a specific frequency. Quad antennas have about equal gain as well. A quads main advantage is that it's characteristic impedance is closer to that of coax than a yagi, it has wider bandwidth and it's beamwidth may be narrower than a yagi depending on it's construction.
   c. The quad antenna is a somewhat recent development in antennas. It was invented just after the end of world two in Quito Ecuador by a group know by their call sign of HCJB. This you may know as a Christian shortwave broadcast group. Incidentally, their headquarters is now on Garden of the Gods road right here in Colorado Springs. As the story goes they were broadcasting from high in the Andes mountains at about 10-11,000 feet. Over the years they had tried several different styles of antennas and at that altitude with it's thin air and high RF power of ten thousand to a hundred thousand watts the exposed ends of all antenna elements were literally being burned off from corona discharges from the high voltages. Remember at the end of a quarter wavelength the voltage is very high. Continuing replacement of these elements was expensive, difficult, hazardous and caused off the air time. One afternoon three engineers sat down to discuss the problem and think about possible solutions. Within 45 minutes they had invented the quad antenna as we know it. With in three hours from their start they had constructed and tested their first model. Notice the quad antenna has a continuous loop without ends. Thus, no more burned antenna element ends and gone were the problems of replacing them. The result of that is the modern day quad antenna.

Well, with that interesting story we conclude this six part series on transmission lines and antennas. Hopefully, I have either been able to remind you of forgotten antenna principals or have sparked and interest in this most interesting subject. If I've bored you please forgive that….it was not intentional.