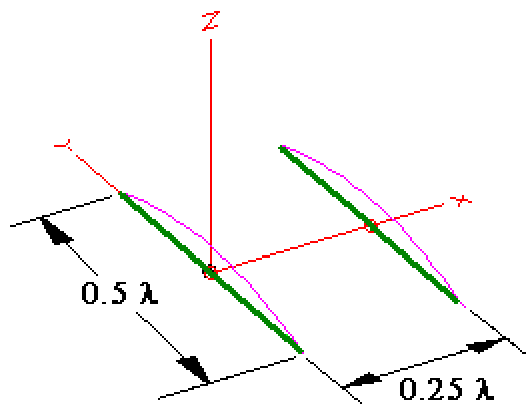
**LARGE LOOP ANTENNAS**

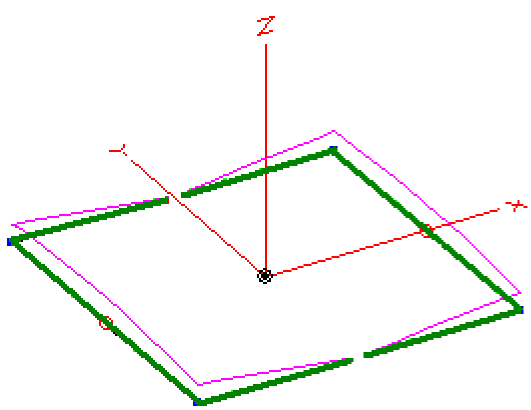
A large loop antenna consists of approximately 1 wavelength of wire. The loop may be square, circular, triangular or any other shape. Because the loop is relatively long, the current distribution along the antenna is no longer constant, as it was for the small loop. As a result, the behavior of the large loop is unlike its smaller cousin.

The current distribution and radiation pattern of a large loop can be derived by folding two half wave dipoles and connecting them as shown in the diagrams below:

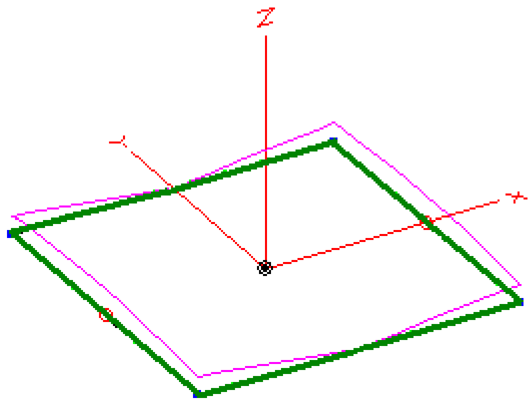
We begin with two □/2 dipoles separated by □/4. RF is fed into the center of each dipole. The resulting current distribution is shown below as a pink line. Note that the current is zero at the dipoles' ends,




Now each dipole is folded in towards the other in a "U" shape as shown below. The current distribution has not changed - the antenna current is still zero at the ends.

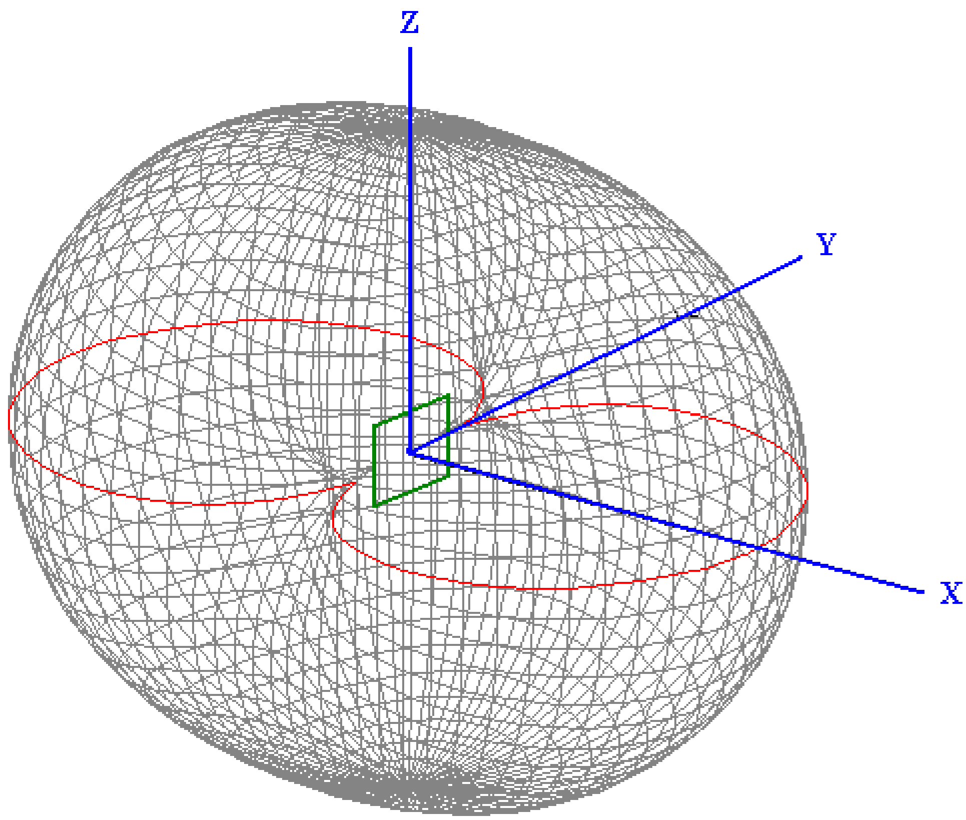



Since the current at the ends is zero, it would be OK to connect the ends to make a loop as shown below.



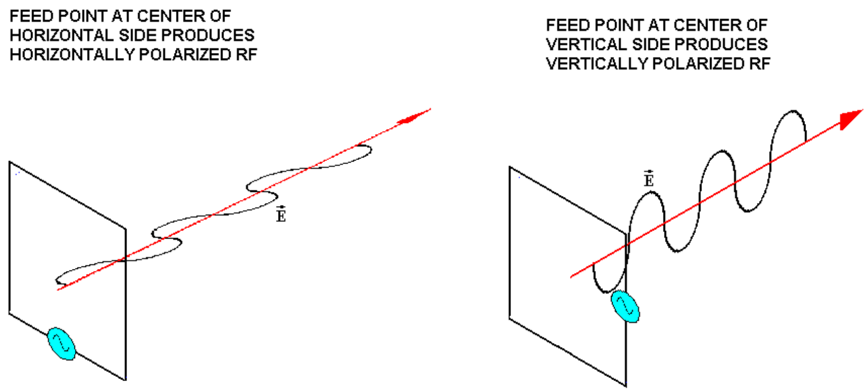

We have now created a square loop of wire whose circumference is 1 wavelength. From an electrical point of view, we have just shown that the large loop is equivalent to two bent dipole antennas.

The radiation pattern of a loop antenna is shown below:



A horizontal slice of the radiation pattern in the XY plane is highlighted in red. It is similar to the figure-8 pattern of a dipole.

It is possible to create either horizontally or vertically polarized radiation with a large loop antenna. The polarization is determined by the location of the feed point as shown below. If the feed point is in a horizontal side of the loop, the polarization is horizontal. If the feed point is in a vertical side of the loop, the polarization is vertical.




So far we have looked at square loop antennas. One of the interesting things about the large loop antenna is that the shape is not important. As long as the perimeter of the antenna is approximately 1 wavelength, the loop antenna will produce a radiation pattern very similar to the one shown above. The shape of the loop may be circular, square, triangular, rectangular, or any other polygonal shape. While the shape of the radiation pattern is not dependent on the shape of the loop, the gain of the loop does depend on the shape. In particular, the gain of the loop is dependent on the area enclosed by the wire. The greater the enclosed area, the greater the gain. The circular loop has the largest gain and the triangular loop has the least. The actual difference between the gain of the circular loop and triangular loop is less than 1 dB, and is usually unimportant.

Loop antennas may be combined to form arrays in the same manner as dipoles. Arrays of loop antennas are called "quad arrays" because the loops are most often square. The most common type of quad array is a Yagi-Uda array using loops rather than dipoles as elements. This type of array is very useful at high elevations, where the combination of high voltage at the element tips of the dipoles in a standard Yagi array and the lower air pressure lead to corona discharge and erosion of the element . In fact, the first use of a quad array was by a broadcaster located in Quito, Ecuador (in the Andes Mountains) in the 1930's.

The input impedance of a loop depends on its shape. It ranges from approximately 100 ohms for a triangular loop to 130 ohms for a circular loop. Unlike the dipole, whose input impedance presents a good match to common 50 or 75 ohm transmission lines, the input impedance of a loop is not a good match and must be transformed to the appropriate impedance.

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