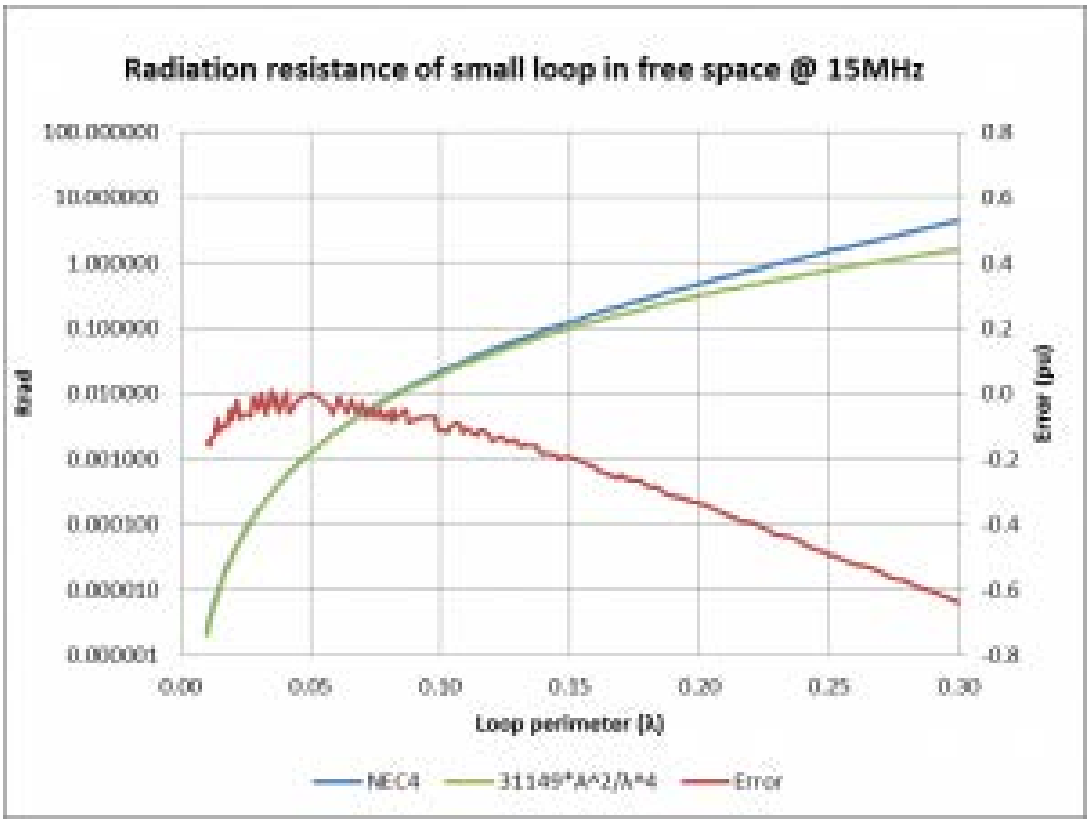
# Accuracy of estimation of radiation resistance of small transmitting loops

A simple formula exists for calculation of radiation resistance of a small transmitting loop in free space. The derivation is in most good antenna text books.

$$R_r = \frac{\mu_0 \, c_0}{6\,\pi} \, A^2 \, (\frac{2\,\pi}{\lambda})^4$$

The expression depends on an assumption that current around the loop is uniform, so the question is what is the acceptable limit for loop size.

NEC might provide some guidance. A series of NEC-4 models of a octagonal loop of thin lossless wire in free space was constructed with varying perimeter. Perimeter shown is that of a circle of the same area.




Above is a comparison of the two methods of estimation of Rr. To the extent that we trust NEC-4, the graph indicates that error in the simple formula grows quickly for loop perimeter greater than 0.1λ. (The results using NEC-2 are visually identical.)

https://owenduffy.net/blog/?p=4970

Many authors set the criteria for a small loop to perimeter<0.3λ, but it is clear that current is not sufficiently uniform for perimeter>0.1λ for estimation of Rr as 31149*(A/λ^2)^2 to 0.1pu error or better.

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