

Modeling skin effect in coaxial configuration

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March 07,
2001

Magnetic permeability of free space (Wb/A-inch)	$\mu_0 := 3.192 \cdot 10^{-08}$
Resistivity of copper at room temperature	$\rho := 6.787 \cdot 10^{-7}$
Diameter of shield (RG-58/U)	$DS := .116$
Number of concentric rings in center conductor	$N := 40$ $n := 0, 1.. N - 1$
Center conductor diameter (RG-58/U)	$DC := .032$ $m := 0, 1.. N - 1$
Ring thickness	$dr := \frac{DC}{2 \cdot N}$
Radius of each ring	$r_n := (n + 1) \cdot dr$
Resistance of each ring (ohm/inch)	$R_n := \begin{cases} \frac{\rho}{\pi \cdot (r_n)^2} & \text{if } n=0 \\ \frac{\rho}{\pi \cdot [(r_n)^2 - (r_{n-1})^2]} & \text{otherwise} \end{cases}$
Inductance of each ring (Henries/inch)	$L_n := \frac{\mu_0}{2 \cdot \pi} \cdot \ln \left(\frac{DS}{2 \cdot r_n} \right)$
Mutual inductances between rings	$LM_{n,m} := \begin{cases} L_n & \text{if } n \geq m \\ L_m & \text{otherwise} \end{cases}$
Mutual resistances between rings	$RM_{n,m} := \begin{cases} R_n & \text{if } n=m \\ 0 & \text{otherwise} \end{cases}$
We constrain the longitudinal voltages across each ring to be the same	$V_m := 1$
System equations	$A(s) := RM + s \cdot LM$
	$I(s) := A(s)^{-1} \cdot V$
List of frequencies of interest	
$K := 7$	$k := 0, 1.. K$
	$f_k := 10^{\frac{k}{2} + \frac{9}{2}}$
	$s := 2j \cdot \pi \cdot f$

Compute fractional current distribution at each frequency

$$I0(s) := \frac{I(s)}{\sum I(s)}$$

Compute effective resistance at each frequency

$$Reff(s) := \frac{\sum \left[R \cdot \overline{(I(s) \cdot I(s))} \right]}{\overline{(\sum I(s)) \cdot (\sum I(s))}}$$

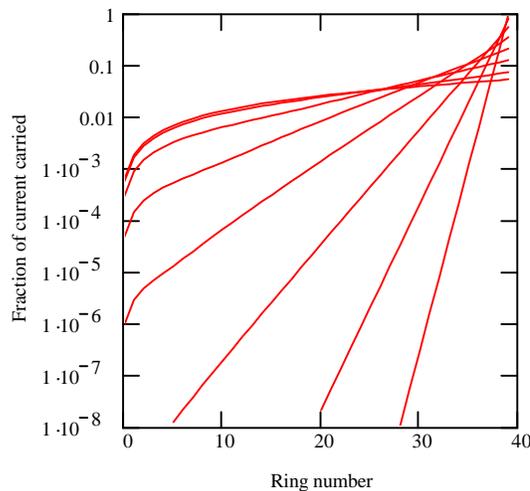
Plotting control paramters. Make K plots, one for each frequency. Each plot shows the distribution of current versus ring number at frequency s[k].

$$PLOT^{<k>} := \overline{I0(s_k)}$$

$$OFFSCREEN_{0,k} := 10^{100}$$

$$PLOT := \text{stack}(PLOT, OFFSCREEN)^T \quad nplot := 0, 1..N$$

The current distribution at DC is nearly flat, according to the resistance of each ring.



The current distribution at high frequencies skews heavily towards the outer ring.

Look! The effective resistance Reff() really grows with sqrt(f)

