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$$\mu_o := 4 \cdot \pi \cdot 10^{-7} \text{ H/m} \quad \varepsilon_o := 8.854 \cdot 10^{-12} \text{ F/m} \quad \underline{\underline{c}} := 2.998 \cdot 10^8 \text{ m/s}$$

$$\rho := 1.7 \cdot 10^{-8} \text{ } \Omega \text{ m} \quad l := 15 \text{ m}$$

$$r_{1,1} := 0.4 \cdot 10^{-3} \text{ m} \quad r_{2,2} := r_{1,1} \quad r_{1,2} := 1.2 \cdot 10^{-3} \text{ m}$$

$$Lc_1 := \frac{\mu_o \cdot l}{2 \cdot \pi} \cdot \ln\left(\frac{r_{1,2}}{r_{1,1}}\right) \quad Lc_2 := \frac{\mu_o \cdot l}{2 \cdot \pi} \cdot \ln\left(\frac{r_{1,2}}{r_{2,2}}\right) \quad Lc_3 := \frac{\mu_o \cdot l}{2 \cdot \pi} \cdot \ln\left(\frac{l}{r_{1,2}}\right)$$

$$Rss_1 := \frac{\rho \cdot l}{\pi \cdot (r_{1,1})^2} \quad Rss_2 := Rss_1 \quad Rss_3 := 0$$

$$F_x := \frac{4 \cdot \rho}{\mu_o \cdot \pi \cdot (r_{1,1})^2} = 1.077 \times 10^5 \text{ Hz}$$

$$Cc := \left(\frac{l}{c}\right)^2 \cdot \frac{1}{Lc} \quad Gc := \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

$$\frac{Lc}{2} = \begin{pmatrix} 1.648 \times 10^{-6} \\ 1.648 \times 10^{-6} \\ 1.415 \times 10^{-5} \end{pmatrix} \quad Cc = \begin{pmatrix} 7.595 \times 10^{-10} \\ 7.595 \times 10^{-10} \\ 8.846 \times 10^{-11} \end{pmatrix} \quad \frac{Rss}{2} = \begin{pmatrix} 0.254 \\ 0.254 \\ 0 \end{pmatrix} \quad Rrad := 73$$

$$Zo := \sqrt{\frac{Lc}{Cc}} \quad Zo = \begin{pmatrix} 65.873 \\ 65.873 \\ 565.632 \end{pmatrix} \quad Rn := Zo_1 + Zo_2 \quad Rf := Rn$$

$$Rn = 131.746 \text{ } \Omega$$

$$Fq := \frac{1}{4 \cdot \sqrt{Lc_1 \cdot Cc_1}} = 4.997 \times 10^6 \text{ Hz}$$

Figure 5.4.2 Calculating values for the circuit components

$$\text{Zbranch}(f) := \left| \begin{array}{l} \omega \leftarrow 2 \cdot \pi \cdot f \\ \text{for } i \in 1 \dots 3 \\ \quad \text{Rc}_i \leftarrow \text{Rssi} \cdot \sqrt{1 + \frac{f}{F_x}} \\ \quad \theta \leftarrow \sqrt{(\text{Rc}_i + j \cdot \omega \cdot \text{Lc}_i) \cdot (\text{Gc}_i + j \cdot \omega \cdot \text{Cc}_i)} \\ \quad \text{Zo} \leftarrow \sqrt{\frac{\text{Rc}_i + j \cdot \omega \cdot \text{Lc}_i}{\text{Gc}_i + j \cdot \omega \cdot \text{Cc}_i}} \\ \quad \text{Z}_{1,i} \leftarrow \text{Zo} \cdot \tanh\left(\frac{\theta}{2}\right) \\ \quad \text{Z}_{2,i} \leftarrow \text{Zo} \cdot \text{csch}(\theta) \\ \text{Z} \end{array} \right.$$

$$\text{Zloop}(f) := \left| \begin{array}{l} \text{Z} \leftarrow \text{Zbranch}(f) \\ \text{Z}_{11} \leftarrow \text{Z}_{1,1} + \text{Z}_{2,1} + \text{Z}_{2,2} + \text{Z}_{1,2} + \text{Rn} \\ \text{Z}_{12} \leftarrow -(\text{Z}_{2,2} + \text{Z}_{2,1}) \\ \text{Z}_{13} \leftarrow -(\text{Z}_{1,2} + \text{Z}_{2,2}) \\ \text{Z}_{22} \leftarrow \text{Z}_{1,2} + \text{Z}_{2,2} + \text{Z}_{2,1} + \text{Z}_{1,1} + \text{Rf} \\ \text{Z}_{23} \leftarrow \text{Z}_{2,2} \\ \text{Z}_{33} \leftarrow \text{Z}_{1,2} + \text{Z}_{2,2} + \text{Z}_{2,3} + \text{Z}_{1,3} + \text{Rrad} \\ \begin{pmatrix} \text{Z}_{11} & \text{Z}_{12} & \text{Z}_{13} \\ \text{Z}_{12} & \text{Z}_{22} & \text{Z}_{23} \\ \text{Z}_{13} & \text{Z}_{23} & \text{Z}_{33} \end{pmatrix} \end{array} \right.$$

$$\underline{\underline{\text{S}}} := 1 \quad \underline{\underline{\text{Zo}}} := 377$$

$$\text{Vthreat}(f) := \left| \begin{array}{l} \lambda \leftarrow \frac{c}{f} \\ \text{Va} \leftarrow \sqrt{\text{S} \cdot \text{Zo}} \cdot \frac{\lambda}{\pi} \\ \text{Vb} \leftarrow \text{Va} \sin\left(2 \cdot \pi \cdot \frac{l}{\lambda}\right) \\ \text{Vb} \leftarrow \text{Va} \quad \text{if } l > \frac{\lambda}{4} \end{array} \right.$$

Fig 5.4.5 Calculating values for impedance matrix and threat voltage at each frequency

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$n := 100$ $s := 1 \dots 20 \cdot n$ $F_s := s \cdot \frac{F_q}{n}$

$I_{threat_s} :=$ $\left| \begin{array}{l} f \leftarrow F_s \\ Z \leftarrow Z_{loop}(f) \\ V \leftarrow \begin{pmatrix} 0 \\ 0 \\ V_{threat}(f) \end{pmatrix} \\ I \leftarrow \text{lsolve}(Z, V) \\ I_{out} \leftarrow |I_1| \\ I_{out} \leftarrow 10^{-2} \text{ if } I_{out} \leq 10^{-2} \end{array} \right|$ $\max(I_{threat}) = 1.031$

Fig 5.4.6 Calculating frequency response of the threat current

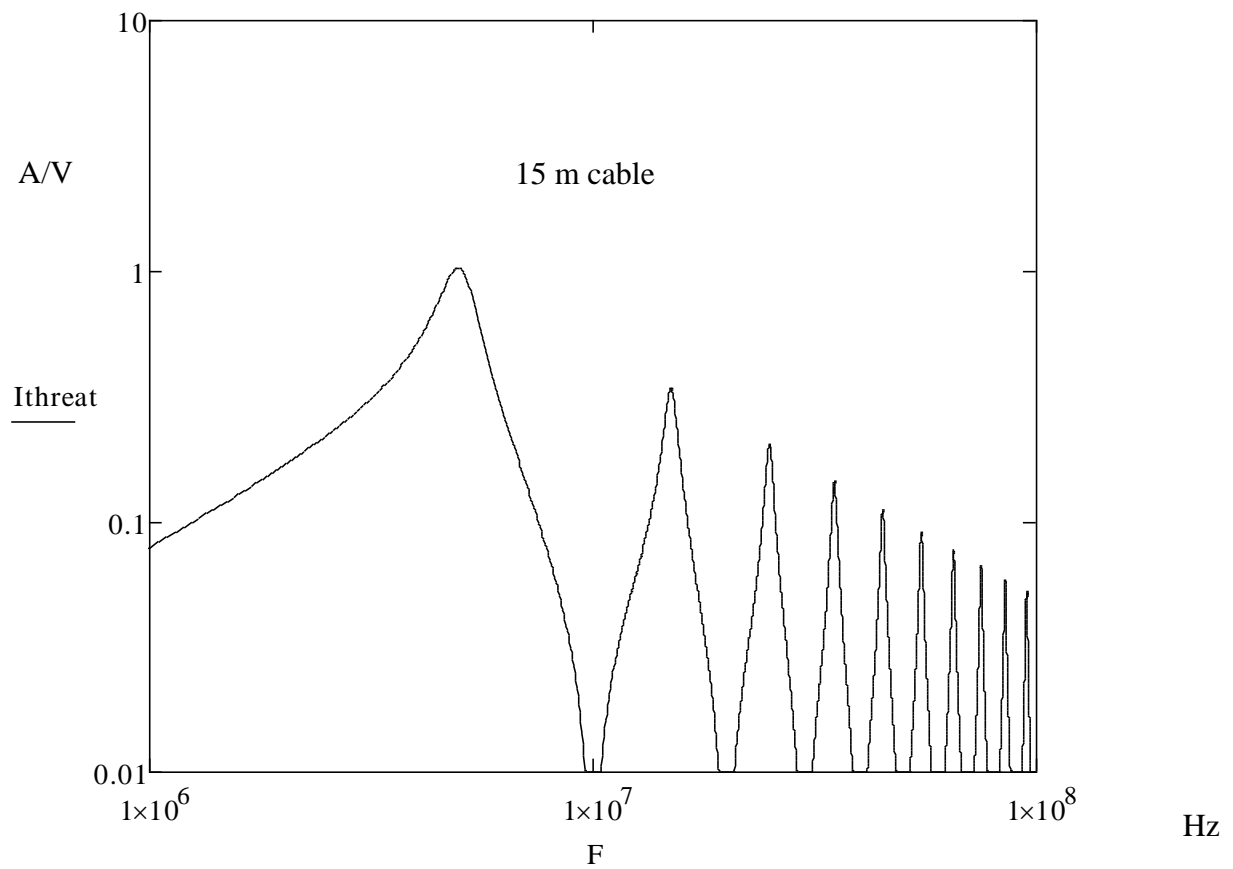


Fig 5.4.7 Frequency response of threat current