

An FR-4 PCB datasheet gives that the relative permittivity is 4.80 and the loss tangent (AKA dissipation factor) is 0.022 at 1 MHz at 20°C. Determine ϵ' , ϵ'' , and the effective conductivity σ of this FR-4.

Given $\epsilon_r = 4.80$ and $\tan \delta = 0.022$ @ 1 MHz

Per notes,

$$\epsilon' = \epsilon_r \epsilon_0 = 4.8 (8.8541878 \times 10^{-12})$$

$$\underline{\underline{\epsilon' = 4.2500 \times 10^{-11} \text{ F/m}}}$$

$$\epsilon'' = \epsilon' \tan \delta = 4.25 \times 10^{-11} (0.022)$$

$$\underline{\underline{\epsilon'' = 9.3500 \times 10^{-13} \text{ F/m}}}$$

$$\epsilon'' = \sigma / \omega \Rightarrow \sigma = \epsilon'' \omega$$

$$= 9.35 \times 10^{-13} (2\pi) 10^6$$

$$\underline{\underline{\sigma = 5.8748 \times 10^{-6} \text{ S/m}}}$$