CALCULATING SKIN DEPTHS

According to the International Telephone and Telegraph Corporation “Reference Data for Radio Engineers,” the value of skin depth, δ, is calculated by:

$$\delta = \sqrt{\frac{2}{\mu_r \sigma_r \omega}}$$

(in meters since the values of μ_r and σ_r are expressed with relationship to meters)

where, $\omega = 2\pi f$ and f is the frequency in Hz.

For reference, the conductivity of annealed copper is given as the symbol σ, where

$$\sigma = 5.82 \text{ x } 10^7 \text{ mhos/meter for copper}$$

with the relative values for other metals assigned the symbol σ_r.

σ_r is a numerical value that results by applying the factor indicated by that designated for σ_r to the value of the reference. What it means is that the reference number of the material noted above, 5.82x10(7) mhos/meter for copper, is the base and that the “relative” number is the base number multiplied by the factor for the alternate material and shown as σ_r. So, a value of $\sigma_r = 0.5$ means 0.5 times the σ value for copper ($5.82 \text{ x } 10^7$ mhos/m).

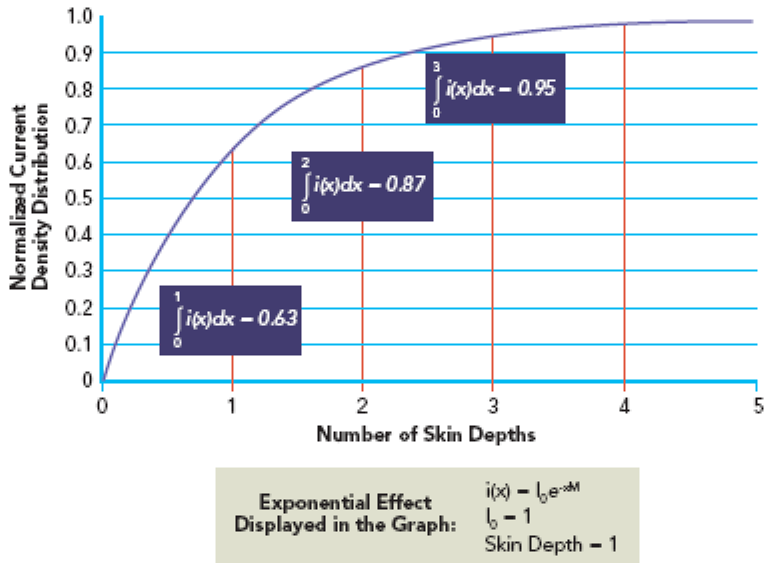
The permeability of free space is μ, where

$\mu = 4\pi \text{ x } 10^{-7}$ H/m for free space

with the relative values of other materials assigned the symbol μ_r.

μ_r is a numerical value that results by applying the factor indicated by that designated for μ_r to the value of the reference. Similar to the previous example, if you have a μ_r of 2, it means that it is the value of $\mu = 4\pi \text{ x } 10^{-7}$ H/m for free space times 2.

The calculations show it requires five skin depths to capture approximately 99 percent of the current density. Skin depths of 4 = 97, 3 = 95, 2 = 87, and 1 = 63 percent, capture progressively low current densities.



The exponential effect for approximating the current density captured towards the surfaces of a conductor at various skin depths.