

Skin Effect

Electrical Engineering

Why high-frequency current crowds to the surface, and how deep it goes.

At high frequency current crowds into a thin surface layer, raising a conductor's effective resistance.

COPPER AT 50 HZ

9.4 mm

COPPER AT 1 MHZ

66 μm

COPPER AT 1 GHZ

2.1 μm

- Depth falls as the square root of frequency
- Better conductivity gives a thinner skin
- Extra thickness beneath the skin does nothing
- Litz wire splits current between fine strands
- Surface plating matters, because current rides on top
- AC resistance can far exceed the DC value

LOOK FOR IT

Above roughly 1 MHz a solid 2 mm wire behaves like a thin tube with an unused centre.

Skin depth $\delta = \sqrt{2/(\omega\mu\sigma)}$, where σ is conductivity. A poorer conductor therefore has a deeper skin, not a shallower one.