Coaxial cable: electric field

Physics 225 – Background wiki

Ideal parallel plate capacitor

A co-axial cable consists of an inner conducting cylindrical core, surrounded by an insulating layer, which is in turn surrounded by a conducting cylindrical shield, and finally wrapped in an insulating jacket. A coaxial cable is shown in cut-away view, and in cross section, in Figure 1:

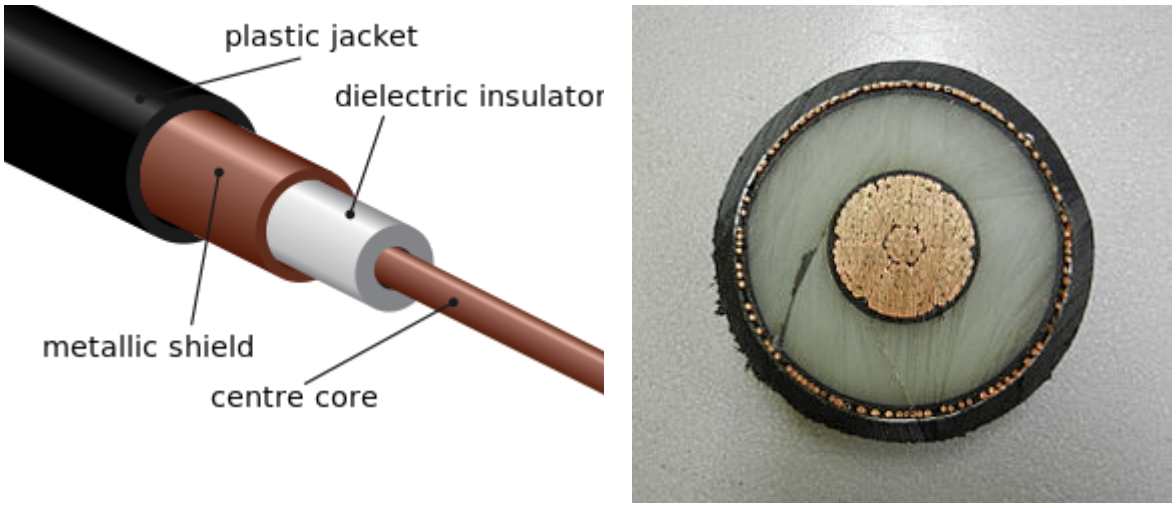

Figure 1: Coaxial cable image source: https://en.wikipedia.org/wiki/Coaxial_cable

The center core and outer shield carry equal and opposite charges. The direction of the electric field is radial (pointing away from the positive conductor, and towards the negative conductor. In between the core and shield, the electric field decreases with distance from the axis:

$$E = \frac{\lambda}{2\pi\kappa\varepsilon_0 r} \quad \text{(Equation 1)}$$

In Equation 1:

- κ is the relative permittivity of the material between the core and the shield,
- ε_0 is the permittivity of free space, $8.854 * 10^{-12}\ \frac{F}{m}$
- λ is the linear charge density of the core, and
- r is the distance from the center of the cable

Outside the metallic shield the electric field is zero.

Credits

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