

Transmission Lines

Electrical Engineering

Characteristic impedance, propagation velocity, and when a wire stops being a wire.

A line behaves as a distributed circuit once its length is a noticeable fraction of a wavelength.

$$Z_0 = \sqrt{L/C} \cdot v_p = 1/\sqrt{LC} \cdot \lambda = v_p/f$$

Common RF coax

75 Ω for video.

$Z_0 = 50 \Omega$

Velocity factor 0.66

Solid dielectric.

2×10^8 m/s

Rule of thumb

Below that, lumped.

Distributed past $\lambda/10$

THE COMMON MISTAKE

✗ **Believing Z_0 is a resistance you can measure**

✓ **It is wave voltage divided by wave current**

An ohmmeter on an open 50 Ω cable reads infinity. Z_0 describes a travelling wave, not a DC path between the conductors.

Z_0 is set by geometry and dielectric, never by length. Cutting a cable in half leaves its characteristic impedance unchanged.