Coaxial Cable Characteristic Impedance, Capacitance and Velocity

Characteristic impedance, capacitance and inductance per metre, velocity factor and delay of a coaxial line from its conductor diameters and dielectric constant.

Method: Coaxial transmission line parameters

Input parameters

Unit system: SI

Parameter	Value	Unit
Inner diameter of the outer conductor (shield)	7.2400	mm
Diameter of the inner conductor	2.2600	mm
Relative permittivity of the dielectric (PE 2.25, PTFE 2.1, foam ≈1.5)	2.2500	

Calculated results

Parameter	Value	Unit
Characteristic impedance	46.538	Ω
Capacitance per metre	107.51	pF/m
Inductance per metre	0.23285	µH/m
Velocity factor 1/√ε_r	0.66667	
Delay per metre (ns/m)	5.0035	

Notes for this case

- Lossless coaxial line: Z_0 = (60/√ε_r) ln(D/d) Ω. The delay is shown in nanoseconds per metre.

Formula and method

$$Z_0 = \frac{60}{\sqrt{\varepsilon_r}} \ln\frac{D}{d}, \quad C' = \frac{2\pi\varepsilon_0\varepsilon_r}{\ln(D/d)}, \quad L' = \frac{\mu_0}{2\pi} \ln\frac{D}{d}, \quad VF = \frac{1}{\sqrt{\varepsilon_r}}$$

Variables

D	Inner diameter of the outer conductor (shield)	m
d	Diameter of the inner conductor	m
ε_r	Relative permittivity of the dielectric (PE 2.25, PTFE 2.1, foam ≈1.5)	-
Z_0	Characteristic impedance	Ω
C'	Capacitance per metre	F/m
L'	Inductance per metre	H/m
VF	Velocity factor 1/√ε_r	-
t_d	Delay per metre (ns/m)	-

Method and standards

Coaxial line theory.

Assumptions and limits

- Lossless line, TEM mode, non-magnetic materials.

References

Coaxial transmission line parameters

Report details

Report reference	FCC-A863-07HN (the same inputs always give the same reference)
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/electrical/electronics/coaxial-cable-impedance

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.