Overhead Line Inductance and Capacitance from Conductor Spacing

Inductance, capacitance, reactance and susceptance per km of a three-phase overhead line from conductor radius and the spacing between phases.

Method: Stevenson and Grainger; Power System Analysis (McGraw-Hill, 1994); Kothari and Nagrath; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Conductor radius	12.500	mm
Spacing phase 1–2	4.0000	m
Spacing phase 2–3	4.0000	m
Spacing phase 3–1	8.0000	m
Frequency	50.000	Hz

Calculated results

Parameter	Value	Unit
Geometric mean distance	5.0397	m
Inductance per length	1.2499	mH/km
Reactance (Ω/km)	0.39266	
Capacitance to neutral per length	9.2731	nF/km
Susceptance (µS/km)	2.9132	

Notes for this case

• Solid round conductor (GMR = 0.7788r) and a fully transposed line; stranded and bundled conductors use the maker's GMR. Earth effect on capacitance neglected.

Formula and method

$$GMD = \sqrt[3]{D_{12}D_{23}D_{31}}, \quad L' = 2\times10^{-7}\ln\frac{GMD}{0.7788r}, \quad C' = \frac{2\pi\varepsilon_0}{\ln(GMD/r)}$$

Variables

r	Conductor radius	m
D_{12}	Spacing phase 1–2	m
D_{23}	Spacing phase 2–3	m
D_{31}	Spacing phase 3–1	m
f	Frequency	1/s
GMD	Geometric mean distance	m
L'	Inductance (mH/km)	-
X'	Reactance (Ω/km)	-
C'	Capacitance to neutral (nF/km)	-
B'	Susceptance (µS/km)	-

Method and standards

Line constants.

Assumptions and limits

- Transposed; solid conductors. There is no GMR input: for stranded (ACSR) or bundled conductors the maker's GMR differs from

0.7788r, so the inductance here is approximate.

- $L' = 2 \times 10^{-7}$ ln(GMD/GMR) H/m uses the classical $\mu_0/2\pi = 2 \times 10^{-7}$. Results are shown in mH/km, Ω/km, nF/km and µS/km in every unit system.

References

- Stevenson and Grainger
- Power System Analysis (McGraw-Hill, 1994); Kothari and Nagrath
- Modern Power System Analysis
- 4th ed. (2011) ($L = 2\times10^{-7}$ ln(GMD/GMR) H/m, $C = 2\pi\varepsilon_0/\ln(GMD/r)$ F/m)

Report details

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

This calculator online

https://calc.firecad.com/electrical/power/line-inductance-capacitance

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.