Cable Voltage Drop (IEC 60364)

Voltage drop and power loss of a copper or aluminium cable, three-phase or single-phase, by the IEC 60364-5-52 Annex G formula.

Method: IEC 60364-5-52:2009 Annex G

Input parameters

Unit system: SI

Parameter	Value	Unit
System	Three-phase	
Nominal voltage (line-to-line for three-phase) Annex G is for low-voltage installations up to 1 000 V.	415.00	V
Design current	100.00	A
Cable length (one way)	120.00	m
Conductor cross-section	35.000	mm²
Conductor	Copper	
Load power factor	0.85000	
Reactance per unit length of conductor 0.08 mΩ/m is the IEC 60364-5-52 Annex G value when the cable data sheet gives none.	0.080000	mΩ/m

Calculated results

Parameter	Value	Unit
Voltage drop in per cent of the phase voltage	2.9478	%
Voltage drop, line to neutral (single-phase: in the circuit)	7.0629	V
Voltage drop, line to line (single-phase: same as above)	12.233	V
Voltage at the load	402.77	V
Conductor resistance in service (one conductor)	0.077143	Ω
Power loss in the cable	2.3143	kW

Formula and method

$$u = b\left(\rho_1 \frac{L}{S}\cos\varphi + \lambda L \sin\varphi\right) I_b \qquad \Delta u = \frac{u}{U_0} \qquad U_0 = \frac{U_n}{\sqrt{3}}\ (\mathrm{three-phase}),\ U_n\ (\mathrm{single-phase})$$

$$R = \rho_1 \frac{L}{S} \qquad u_{LL} = \sqrt{3}\ u\ (\mathrm{three-phase}) \qquad U_{load} = \sqrt{3}\,(U_0 - u)\ \text{or}\ U_0 - u \qquad P_{loss} = n\, I_b^2 R$$

Variables

system	three-phase or single-phase	–
U_n	nominal voltage (line to line for three-phase)	V
I_b	design current	A
L	cable length, one way	m
S	conductor cross-section	m²
$\mathrm{material}$	copper or aluminium	–
$\cos\varphi$	load power factor	–
λ	reactance per unit length of conductor	Ω/m
Δu	voltage drop in per cent of U_0	–
u	voltage drop, line to neutral (single-phase: in the circuit)	V

u_{LL}	voltage drop, line to line	V
U_{load}	voltage at the load	V
R	resistance of one conductor in service	Ω
P_{loss}	power loss in the cable	W
ρ_1	resistivity in service (Cu 0.0225, Al 0.036 Ω·mm²/m)	Ω·m
U_0	voltage between line and neutral	V

Method and standards

IEC 60364-5-52:2009 Annex G (voltage drop in consumers' installations), including its resistivities in normal service and its default reactance of 0.08 mΩ/m.

Assumptions and limits

- Low-voltage circuits up to 1 000 V; balanced three-phase load.
- Conductor at its normal service temperature (resistivity 1.25 × the 20 °C value); a lightly loaded cable has a smaller drop.
- Steady running current; motor starting current gives a larger, short drop.
- Use the cable maker's reactance where known, especially for single-core cables laid apart.
- Lagging (inductive) or unity power factor only: sin φ is taken as positive. A leading (capacitive) load has a smaller drop than shown.
- Drops above 3 % (lighting) and above 5 % (other uses) are flagged.

References

- IEC 60364-5-52:2009 Annex G

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/cables/cable-voltage-drop

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Reopens the calculator with the inputs of this report.