

Voltage Drop Calculation

Workshop submain: MSB to DB-02

Document	Revision	Date
AMP-VD-DEMO-002	C02 / Design sample	13 October 2026

Calculation summary

The illustrative 400 V, three-phase submain has a calculated voltage drop of 2.07%. Including the assumed 1.10% upstream allowance, the total is **3.17%**, below the example 5.00% target by 1.83 percentage points. **Engineering acceptance remains unassessed.**

1 Scope and assumptions

Balanced three-phase AC load at 0.90 lagging power factor. Route length is one-way. Resistance and reactance remain constant. This example assesses voltage drop only; it does not assess cable capacity, fault withstand, earth-fault loop impedance or protection coordination.

2 Input data

Table 1. Declared inputs and their provenance. All project data are synthetic.

Parameter	Symbol	Value	Unit	Basis
Line-to-line voltage	V	400	V	Sample input [A]
Design current	I	125	A	Sample input [A]
One-way route length	L	85	m	Sample input [A]
Lagging power factor	cos φ	0.90	-	Sample input [A]
Resistance	R	0.462	Ω/km	Illustrative value [B]
Reactance	X	0.080	Ω/km	Illustrative value [B]
Upstream drop allowance	u	1.10	%	Assumed basis [C]
Total voltage-drop target	d _{lim}	5.00	%	Example target [C]

[A] Demonstration input. [B] Not a standards-table or manufacturer selection. [C] Requires an approved project basis. The 5% value is not presented as a universal compliance limit.

3 Calculation method

For the declared balanced three-phase model, with L converted to kilometres:

$$\Delta V = \sqrt{3} \, I \, L \, (R \cos \varphi + X \sin \varphi) \tag{1}$$

$$\Delta V = \sqrt{3} \times 125 \times 0.085 \times (0.462 \times 0.90 + 0.080 \times 0.43589)$$

$$\Delta V = \mathbf{8.29372 \, V} \tag{2}$$

4 Results and criterion

$$d_{\text{total}} = u + (100 \Delta V / V) = 1.10 + 2.07343 = 3.17343\%$$

(3)

Quantity	Result	Interpretation
Submain voltage drop	8.294 V	2.073% of 400 V
Total drop, including upstream	3.173%	Below the 5.00% example target
Remaining numerical margin	1.827 pp	Target minus total drop
Engineering acceptance	UNASSESSED	Input and project review outstanding

5 Sensitivity to route length

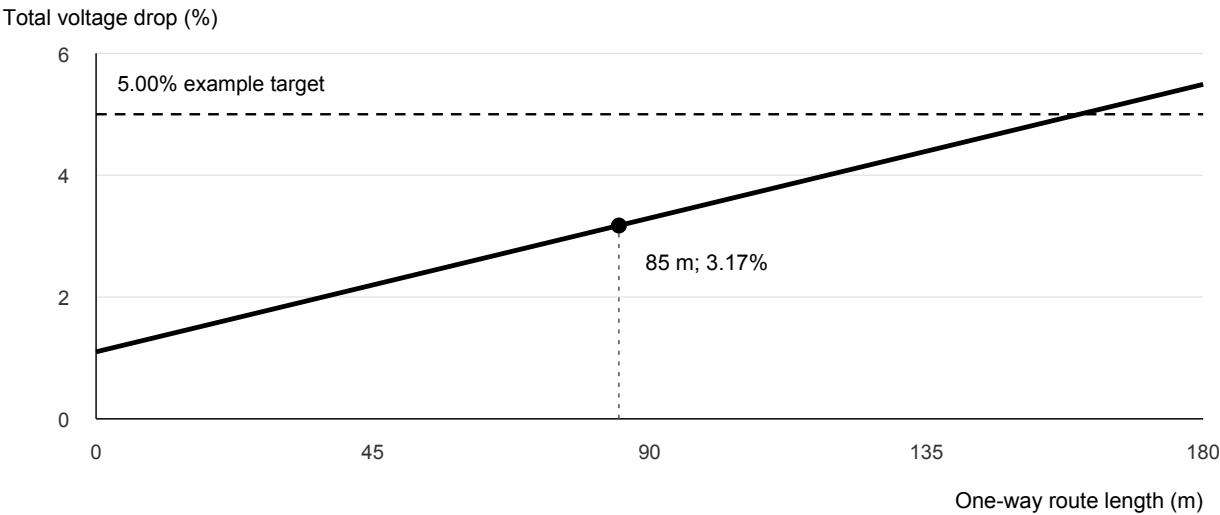


Figure 1. Total voltage drop with current, power factor and impedance held constant. The target is crossed at approximately 159.9 m; this is a mathematical threshold, not an approved cable length.

6 Limitations and review actions

Item	Status	Required review
Impedance provenance	UNVERIFIED	Confirm source and operating conditions.
Project criterion	UNCONFIRMED	Confirm upstream allowance and target.
Other circuit checks	NOT ASSESSED	Complete capacity and protection checks.
Engineering acceptance	UNASSESSED	Independent review remains outstanding.

7 Document control

Prepared by	Checked by	Issue status
Design sample	Not assigned	Not issued

Provenance: demonstration generator; no production engine version, saved-study digest or verification receipt is claimed.