Power Factor Correction Capacitor (kvar)

Capacitor kvar needed to raise the power factor of a load, with kVA and line current before and after and the reduction in line losses.

Method: IEC 60831-1 (shunt power capacitors, context); power triangle definitions

Input parameters

Unit system: SI

Parameter	Value	Unit
Active power of the load	500.00	kW
Present power factor	0.75000	
Target power factor	0.95000	
Line-to-line voltage (three-phase)	415.00	V

Calculated results

Parameter	Value	Unit
Capacitor rating required	276.62	kvar
Reactive power before	440.96	kvar
Reactive power after	164.34	kvar
Apparent power before	666.67	kVA
Apparent power after	526.32	kVA
Line current before	927.47	A
Line current after	732.21	A
Reduction of line losses (I² R)	37.673	%

Formula and method

$$Q_c = P(\tan\varphi_1 - \tan\varphi_2) \qquad Q_1 = P\tan\varphi_1 \qquad Q_2 = P\tan\varphi_2$$

$$S_1 = \frac{P}{\cos\varphi_1} \qquad S_2 = \frac{P}{\cos\varphi_2} \qquad I = \frac{S}{\sqrt{3}\,U} \qquad \Delta P_{loss} = 1 - \left(\frac{\cos\varphi_1}{\cos\varphi_2}\right)^2$$

Variables

P	active power of the load	W
$\cos\varphi_1$	present power factor	–
$\cos\varphi_2$	target power factor	–
U	line-to-line voltage	V
Q_c	capacitor rating required	var
Q_1	reactive power before	var
Q_2	reactive power after	var
S_1	apparent power before	VA
S_2	apparent power after	VA
I_1	line current before	A
I_2	line current after	A
ΔP_{loss}	relative reduction of the I²R losses upstream	–

Method and standards

The power triangle for a balanced three-phase load: active power is unchanged, the capacitor supplies the difference in reactive

power. Capacitor ratings and duty are covered by IEC 60831-1.

Assumptions and limits

- Sinusoidal voltage and current; harmonics need detuned banks and a separate study.
- Capacitor output is rated at its rated voltage; at a lower voltage it delivers $(U/U_r)^2$ of its rating.
- Losses are those upstream of the capacitor; the capacitor itself has small losses not included.

References

- IEC 60831-1 (shunt power capacitors, context); power triangle definitions

Report details

Report reference	FCC-E133-7S69 (the same inputs always give the same reference)
Generated	17 November 2026, 19:44 UTC
Calculator	Power Factor Correction Capacitor (kvar)
Method last reviewed	10 November 2026
Software release	FireCAD Calc, release of 17 November 2026
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/power/power-factor-correction

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.