Transformer Reactive Power and Fixed Capacitor Compensation

Reactive power a transformer draws at no load and at a loading, from its no-load current and impedance, and the fixed capacitor for its no-load magnetising kvar.

Method: Transformer reactive power from no-load current and impedance

Input parameters

Unit system: SI

Parameter	Value	Unit
Transformer rating	1,000.0	kVA
No-load current (share of rated)	1.5000	%
Impedance voltage	5.0000	%
Load as a share of rating	75.000	%

Calculated results

Parameter	Value	Unit
No-load reactive power (fixed capacitor)	15.000	kvar
Leakage reactive power at the load	28.125	kvar
Total reactive power of the transformer	43.125	kvar

Notes for this case

• A transformer draws magnetising reactive power $i_0 \cdot S$ all the time it is energised, and leakage reactive power $u_k \cdot \beta^2 \cdot S$ that grows with the square of the load (taking the impedance as reactive, close for large units). Where the tariff meters on the high-voltage side, a fixed capacitor of about the no-load kvar on the secondary compensates the magnetising part; the load part is compensated with the load. Too large a fixed capacitor raises light-load voltage and can resonate with harmonics.

Formula and method

$$Q_0 = i_0 S, \quad Q_L = u_k \beta^2 S$$

Variables

S	Transformer rating	VA
i_0	No-load current (share of rated)	-
u_k	Impedance voltage	-
β	Load as a share of rating	-
Q_0	No-load reactive power (fixed capacitor)	var
Q_L	Leakage reactive power at the load	var
Q_T	Total reactive power of the transformer	var

Method and standards

Transformer compensation.

Assumptions and limits

- Impedance mostly reactive.

References

Transformer reactive power from no-load current and impedance

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/transformers/transformer-no-load-compensation

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.