Self-Excited Induction Generator Capacitance

Capacitance per phase for a self-excited induction generator in delta or star from its magnetising current and the reactive power of the load.

Method: Reactive power balance of the self-excited induction generator

Input parameters

Unit system: SI

Parameter	Value	Unit
Line voltage	415.00	V
Frequency	50.000	Hz
No-load (magnetising) current	12.000	A
Load real power	15.000	kW
Load power factor (lagging)	90.000	%
Margin on capacitance	1.1000	

Calculated results

Parameter	Value	Unit
Magnetising reactive power	8.6256	kvar
Load reactive power	7.2648	kvar
Capacitance per phase, delta	107.69	µF
Capacitance per phase, star	323.06	µF

Notes for this case

• An induction machine driven above synchronous speed generates only if something supplies its magnetising current. Capacitors must supply Q_m = √3V_LI₀ plus the load's reactive power. Per phase: delta C = Q/(3ωV_L²); star C = Q/(ωV_L²), three times larger for the same kvar. The machine self-excites only with enough residual magnetism and capacitance; voltage and frequency drift with load and speed unless regulated.

Formula and method

$$Q = k\left(\sqrt{3}\,V_L I_0 + P_L \tan\varphi_L\right), \quad C_\Delta = \frac{Q}{3\omega V_L^2}, \quad C_Y = 3C_\Delta$$

Variables

V_L	Line voltage	V
f	Frequency	1/s
I_0	No-load (magnetising) current	A
P_L	Load real power	W
$\cos\varphi_L$	Load power factor (lagging)	-
k	Margin on capacitance	-
Q_m	Magnetising reactive power	var
Q_L	Load reactive power	var
C_Δ	Capacitance per phase, delta	F
C_Y	Capacitance per phase, star	F

Method and standards

Self-excitation.

Assumptions and limits

- Rated voltage and frequency; magnetising current at rated voltage.

References

Reactive power balance of the self-excited induction generator

Report details

Report reference	FCC-7FSH-AVPD (the same inputs always give the same reference)
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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/motors/self-excited-induction-generator

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.