Alternator EMF Equation and Frequency

Generated EMF per phase and line voltage of a three-phase alternator from flux per pole, turns per phase, pitch and distribution factors, with the frequency.

Method: Synchronous machine EMF equation E_ph = √2 π k_p k_d f Φ T_ph (textbook)

Input parameters

Unit system: SI

Parameter	Value	Unit
Number of poles	4.0000	
Speed	1,500.0	rpm
Flux per pole	30.000	mWb
Turns in series per phase	40.000	
Pitch factor	0.96600	
Distribution factor	0.96000	

Calculated results

Parameter	Value	Unit
Frequency P N / 2	50.000	Hz
EMF per phase	247.21	V
Line voltage, star connected	428.18	V
Winding factor k_p k_d	0.92736	

Formula and method

$$f = \frac{PN}{2}, \quad E_{ph} = \sqrt{2}\,\pi\,k_p k_d f \Phi T_{ph} \approx 4.44\,k_p k_d f \Phi T_{ph}$$

Variables

P	Number of poles	-
N	Speed	1/s
Φ	Flux per pole	Wb
T_{ph}	Turns in series per phase	-
k_p	Pitch factor	-
k_d	Distribution factor	-
f	Frequency P N / 2	1/s
E_{ph}	EMF per phase	V
E_L	Line voltage, star connected	V
k_w	Winding factor k_p k_d	-

Method and standards

RMS EMF of a distributed, short-pitched winding.

Assumptions and limits

- Sinusoidal flux distribution.
- The number of poles must be an even whole number.

References

- Synchronous machine EMF equation E_ph = √2 π k_p k_d f Φ T_ph (textbook)

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/power/alternator-emf-equation

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Reopens the calculator with the inputs of this report.