Transformer EMF Equation: Turns, Flux and Core Area

EMF of transformer windings from frequency, turns, peak flux density and core area by E = 4.44 f N Φm, with the volts per turn and the secondary voltage.

Method: Faraday's law for sinusoidal flux: E = √2 π f N Φ_m

Input parameters

Unit system: SI

Parameter	Value	Unit
Frequency	50.000	Hz
Peak flux density in the core	1.2000	T
Net core cross-section	150.00	cm²
Primary turns	2,750.0	
Secondary turns	108.00	

Calculated results

Parameter	Value	Unit
Peak flux B_m A_c	18.000	mWb
Volts per turn	3.9986	V
Primary EMF	10,996	V
Secondary EMF	431.85	V

Notes for this case

- The constant is √2 π = 4.443 for a sinusoidal flux; textbooks round it to 4.44.

Formula and method

$$E = \sqrt{2}\,\pi f N \Phi_m \approx 4.44\, f N \Phi_m, \quad \Phi_m = B_m A_c$$

Variables

f	Frequency	1/s
B_m	Peak flux density in the core	T
A_c	Net core cross-section	m²
N_1	Primary turns	-
N_2	Secondary turns	-
Φ_m	Peak flux B_m A_c	Wb
E_t	Volts per turn	V
E_1	Primary EMF	V
E_2	Secondary EMF	V

Method and standards

RMS value of N dΦ/dt for a sinusoidal flux.

Assumptions and limits

- No saturation check beyond a warning above 1.9 T; grain-oriented silicon steel saturates at about 1.7–1.9 T.
- Sinusoidal flux; no leakage.

References

- Faraday's law for sinusoidal flux: E = √2 π f N Φ_m

Report details

Report reference	FCC-SV6Z-WPSP (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/transformers/transformer-emf-equation

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.