Transformer Turns Ratio, Voltages and Currents

Turns ratio of a single- or three-phase transformer from the line voltages and winding connection (Dy, Yy, Dd, Yd), the secondary turns, and the rated line currents.

Method: Ideal transformer relations (IEC 60076-1 terminology)

Input parameters

Unit system: SI

Parameter	Value	Unit
Primary line voltage	11.000	kV
Secondary line voltage	433.00	V
Rated power	1,000.0	kVA
Phases and connection (primary–secondary)	Three phase, delta–star (Dy)	
Primary turns per phase	1,500.0	

Calculated results

Parameter	Value	Unit
Line voltage ratio V_1 / V_2	25.404	
Primary phase (winding) voltage	11,000	V
Secondary phase (winding) voltage	249.99	V
Turns ratio (winding voltages)	44.001	
Secondary turns per phase	34.090	
Primary line current	52.486	A
Secondary line current	1,333.4	A

Notes for this case

- Turns must be whole: with 34 secondary turns the secondary voltage changes by -0.3 %.
- Ideal transformer at no load: the winding voltages are in the ratio of the turns. Star windings carry line voltage / √3; delta windings the full line voltage.

Formula and method

$$\frac{N_1}{N_2} = \frac{V_{p1}}{V_{p2}}, \quad V_p = V_L \ (\Delta), \ \frac{V_L}{\sqrt{3}} \ (Y)$$

$$I_L = \frac{S}{\sqrt{3}\, V_L} \ (3\phi), \quad \frac{S}{V} \ (1\phi)$$

Variables

V_1	Primary line voltage	V
V_2	Secondary line voltage	V
S	Rated power	VA
conn	Phases and connection (primary–secondary)	-
N_1	Primary turns per phase	-
a_L	Line voltage ratio V_1 / V_2	-
V_{p1}	Primary phase (winding) voltage	V
V_{p2}	Secondary phase (winding) voltage	V

N_1/N_2	Turns ratio (winding voltages)	-
N_2	Secondary turns per phase	-
I_1	Primary line current	A
I_2	Secondary line current	A

Method and standards

Ideal transformer: winding voltages in the turns ratio; star winding voltage is line voltage over √3.

Assumptions and limits

- N_2 is the exact value for the voltage ratio; a real winding has whole turns, so round it and accept the small voltage change (the page shows it), or adjust N_1.
- No-load, ideal transformer.

References

- Ideal transformer relations (IEC 60076-1 terminology)

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-turns-ratio

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.