Transformer Short-Circuit Current (IEC 60909)

Three-phase fault current at the terminals of a transformer fed from an infinite source: the simple I/uk value and the IEC 60909 value with c, KT and peak current.

Method: IEC 60909-0:2016 (short-circuit currents in three-phase a.c. systems); IEC 60076-5 (impedance values)

Input parameters

Unit system: SI

Parameter	Value	Unit
Rated power	1,000.0	kVA
Rated voltage of the faulted side, line to line	433.00	V
Short-circuit (impedance) voltage From the nameplate; IEC 60076-5 recognises minimum values of 4 % up to 630 kVA, 5 % to 1 250 kVA, 6 % to 2 500 kVA.	5.0000	%
Voltage factor c (IEC 60909-0 Table 1) Maximum fault current: 1.05 for low voltage with +6 % tolerance, 1.10 for low voltage with +10 % and for voltages above 1 kV.	1.0500	
Resistance to reactance ratio of the transformer From the load losses: R = P_k / (3 I_r²). Typical 0.1–0.3 for distribution transformers, below 0.1 for large ones.	0.15000	

Calculated results

Parameter	Value	Unit
Initial symmetrical short-circuit current (IEC 60909)	28.904	kA
Peak short-circuit current	67.236	kA
Short-circuit power	21.677	MVA
Simple estimate I_r / u_k	26.667	kA
Rated current	1,333.4	A
Peak factor	1.6449	
Transformer correction factor	0.96876	
Transformer impedance referred to this side	9.3745	mΩ

Formula and method

$$I_r = \frac{S_r}{\sqrt{3}\,U_n} \qquad I_{k,0} = \frac{I_r}{u_k} \qquad Z_T = u_k \frac{U_n^2}{S_r}$$

$$K_T = 0.95\,\frac{c_{max}}{1 + 0.6\,x_T} \qquad I_k'' = \frac{c_{max}\,U_n}{\sqrt{3}\,K_T Z_T} \qquad S_k'' = \sqrt{3}\,U_n I_k''$$

$$\kappa = 1.02 + 0.98\,e^{-3R/X} \qquad i_p = \kappa\sqrt{2}\,I_k''$$

Variables

S_r	transformer rated power	VA
U_n	rated voltage of the faulted side, line to line	V
u_k	short-circuit (impedance) voltage	–
c_{max}	voltage factor of IEC 60909-0	–
R/X	resistance to reactance ratio of the transformer	–
I_k''	initial symmetrical short-circuit current	A

i_p	peak short-circuit current	A
S_k''	short-circuit power	VA
$I_{k,0}$	simple estimate I_r/u_k	A
I_r	rated current	A
κ	peak factor	–
K_T	transformer impedance correction factor	–
Z_T	transformer impedance referred to the faulted side	Ω
x_T	relative reactance of the transformer	–

Method and standards

IEC 60909-0:2016 for a three-phase short circuit fed by a network transformer from an infinite source: transformer impedance from its rated short-circuit voltage, the impedance correction factor K_T for network transformers, the voltage factor c_max of the standard's table, and the peak factor κ from R/X.

Assumptions and limits

- One voltage U is used both as the system nominal voltage U_n (in c U_n) and as the transformer rated voltage U_rT (in Z_T). IEC 60909-0 keeps them apart: for a 433 V transformer on a 400 V system, the standard's result lies between the values obtained with U = 400 V and U = 433 V. Enter the value that matches your study basis.
- Infinite source upstream; network, cable and motor contributions are not included (motors add to the fault current).
- Three-phase symmetrical fault at the transformer terminals.
- R/X from the transformer's load losses; R/X = 0 gives κ = 2, the upper bound.

References

• IEC 60909-0:2016 (short-circuit currents in three-phase a.c. systems)
• IEC 60076-5 (impedance values)

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-short-circuit-current

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Reopens the calculator with the inputs of this report.