Peak and Asymmetrical Fault Current from the X/R Ratio

Peak (first-cycle) short-circuit current and the asymmetrical rms current at a time from the symmetrical fault current and the X/R ratio of the source.

Method: Short-circuit current with DC offset: peak factor κ = 1.02 + 0.98e^(−3R/X); DC decay with τ = X/(ωR)

Input parameters

Unit system: SI

Parameter	Value	Unit
Symmetrical rms fault current	25.000	kA
X/R ratio at the fault	14.000	
Frequency	50.000	Hz
Time after fault inception	0.050000	s

Calculated results

Parameter	Value	Unit
Peak factor	1.8110	
Peak current	64.028	kA
DC time constant	0.044563	s
DC component at t	11.513	kA
Asymmetrical rms current at t	27.523	kA

Notes for this case

• κ = 1.02 + 0.98e^(−3R/X) is the widely used approximation (IEC 60909 form). Breaker making capacity must exceed the peak; breaking capacity is checked at contact parting with the DC component.

Formula and method

$$\kappa = 1.02 + 0.98e^{-3/(X/R)}, \quad i_p = \kappa\sqrt{2}\, I_k, \quad I_{asym}(t) = \sqrt{I_k^2 + \left(\sqrt{2}\, I_k e^{-t/\tau}\right)^2}$$

Variables

I_k	Symmetrical rms fault current	A
X/R	X/R ratio at the fault	-
f	Frequency	1/s
t	Time after fault inception	s
κ	Peak factor	-
i_p	Peak current	A
τ	DC time constant	s
$I_{dc}(t)$	DC component at t	A
$I_{asym}(t)$	Asymmetrical rms current at t	A

Method and standards

DC offset relations.

Assumptions and limits

- Fault at the worst instant; constant AC component.

References

• Short-circuit current with DC offset: peak factor κ = 1.02 + 0.98e^(−3R/X)
• DC decay with τ = X/(ωR)

Report details

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Release checks	2 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/protection/asymmetrical-fault-current

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.