Synchronous Generator Short-Circuit Ratio

Short-circuit ratio of a synchronous generator from its open-circuit and short-circuit characteristics, the saturated synchronous reactance and its value in ohms.

Method: Open- and short-circuit characteristics

Input parameters

Unit system: SI

Parameter	Value	Unit
Field current for rated voltage on open circuit	420.00	A
Field current for rated current on short circuit	610.00	A
Rated line voltage	11.000	kV
Rated apparent power	50.000	MVA

Calculated results

Parameter	Value	Unit
Short-circuit ratio	0.68852	
Saturated synchronous reactance (per unit)	1.4524	
Base impedance	2.4200	Ω
Saturated synchronous reactance	3.5148	Ω
Sustained short-circuit current at the rated-voltage field	1,806.9	A

Notes for this case

• SCR = field current for rated voltage at no load ÷ field current for rated armature current on a sustained three-phase short circuit. It equals the reciprocal of the saturated synchronous reactance in per unit. A high SCR (0.8–1.2 for hydro generators) means a stiffer, larger and more stable machine; turbogenerators are often 0.4–0.7. The sustained short-circuit current at that field is SCR × rated current.

Formula and method

$$SCR = \frac{I_{F,oc}}{I_{F,sc}}, \quad X_{s,sat} = \frac{1}{SCR}\ \text{pu}, \quad Z_b = \frac{V_L^2}{S_n}$$

Variables

$I_{F,oc}$	Field current for rated voltage on open circuit	A
$I_{F,sc}$	Field current for rated current on short circuit	A
V_L	Rated line voltage	V
S_n	Rated apparent power	VA
SCR	Short-circuit ratio	-
$X_{s,sat}$	Saturated synchronous reactance (per unit)	-
Z_b	Base impedance	Ω
I_{sc}	Sustained short-circuit current at the rated-voltage field	A

Method and standards

Short-circuit ratio.

Assumptions and limits

- Steady-state short circuit; three-phase balanced test.

References

Open- and short-circuit characteristics

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/generator-short-circuit-ratio

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.