Current Transformer Knee-Point Voltage Requirement

Minimum knee-point voltage of a protection CT for a through fault from secondary current, CT winding, lead and relay resistance and a transient factor.

Method: CT secondary voltage requirement V_k ≥ K·I_s(R_CT + R_L + R_relay) (protection practice; relay makers' guides)

Input parameters

Unit system: SI

Parameter	Value	Unit
Maximum through-fault current (primary)	20.000	kA
CT ratio (primary/secondary)	400.00	
CT secondary winding resistance	1.5000	Ω
One-way lead resistance	0.50000	Ω
Relay burden resistance	0.10000	Ω
Lead loop	Two leads (earth fault)	
Transient dimensioning factor	2.0000	

Calculated results

Parameter	Value	Unit
Secondary fault current	50.000	A
Total secondary resistance	2.6000	Ω
Required knee-point voltage	260.00	V

Notes for this case

- The factor K covers DC offset and remanence and comes from the relay maker (often 1–2 for overcurrent, larger for differential schemes, up to 1 + X/R for full offset without saturation).

Formula and method

$$V_k \geq K \frac{I_f}{CT}(R_{CT} + nR_L + R_r)$$

Variables

I_f	Maximum through-fault current (primary)	A
CT	CT ratio (primary/secondary)	-
R_{CT}	CT secondary winding resistance	Ω
R_L	One-way lead resistance	Ω
R_r	Relay burden resistance	Ω
leads	Lead loop	-
K	Transient dimensioning factor	-
I_s	Secondary fault current	A
R_{total}	Total secondary resistance	Ω
V_k	Required knee-point voltage	V

Method and standards

Secondary circuit voltage.

Assumptions and limits

- Resistive burden.
- The result is only as good as K: take it from the relay maker's CT requirement for the protection type (the note gives typical

ranges).

References

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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/protection/ct-knee-point-voltage

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.