IDMT Overcurrent Relay Operating Time

Operating time of an IDMT overcurrent relay from fault current, CT ratio, pickup and time multiplier for standard, very and extremely inverse curves.

Method: Inverse-time overcurrent characteristic t = TMS·k/((I/I_s)^α − 1) with the standard inverse; very inverse; …

Input parameters

Unit system: SI

Parameter	Value	Unit
Fault current (primary)	4,000.0	A
CT ratio (primary amps per secondary amp)	400.00	
Relay pickup setting (secondary amps)	1.0000	A
Time multiplier setting	0.20000	
Curve	Standard inverse (0.14, 0.02)	

Calculated results

Parameter	Value	Unit
Plug setting multiplier I_f/(CT·I_s)	10.000	
Operating time	0.59412	s
Time at TMS = 1	2.9706	s

Notes for this case

• Standard IEC-type inverse-time equation t = TMS·k/(PSM^α − 1); curves are commonly considered valid up to about 20 times setting. Grade upstream relays 0.3–0.4 s above downstream ones.

Formula and method

$$PSM = \frac{I_f}{CT \cdot I_s}, \quad t = TMS \frac{k}{PSM^{\alpha} - 1}$$

Variables

I_f	Fault current (primary)	A
CT	CT ratio (primary amps per secondary amp)	-
I_s	Relay pickup setting (secondary amps)	A
TMS	Time multiplier setting	-
curve	Curve	-
PSM	Plug setting multiplier I_f/(CT·I_s)	-
t	Operating time	s
$t_{TMS=1}$	Time at TMS = 1	s

Method and standards

Inverse-time equation.

Assumptions and limits

- Standard IEC-type curves. A PSM above about 20 is flagged (most relays go definite-time there).
- The curve constants are the widely published IEC values (standard inverse 0.14/0.02, very inverse 13.5/1, extremely inverse 80/2, long-time inverse 120/1).

References

• Inverse-time overcurrent characteristic t = TMS·k/((I/I_s)^α − 1) with the standard inverse
• very inverse

- extremely inverse and long-time constants (IEC 60255-151 form)

Report details

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Release checks	3 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/idmt-relay-operating-time

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.