Protection against short-circuits

Figure 1 shows typical let-through or I²t values of overcurrent circuit-breakers. In the case of S201-B16 miniature circuit-breaker, this causes the let-through energy to be limited to approx. 20,000 A²s if a prospective short-circuit current $i_K = 6$ kA occurs. This value is far less than 29,700 A², meaning PVC-insulated Cu cables with a cross-section of 1.5 mm² can be protected in the event of a short-circuit.

Cu cable, PVC-insulated mm²	Max. permitted I²t values A²s
2.5	82,600
1.5	29,700
1.0	13,200
0.75	7,400

Prospective short-circuit current I_k/A
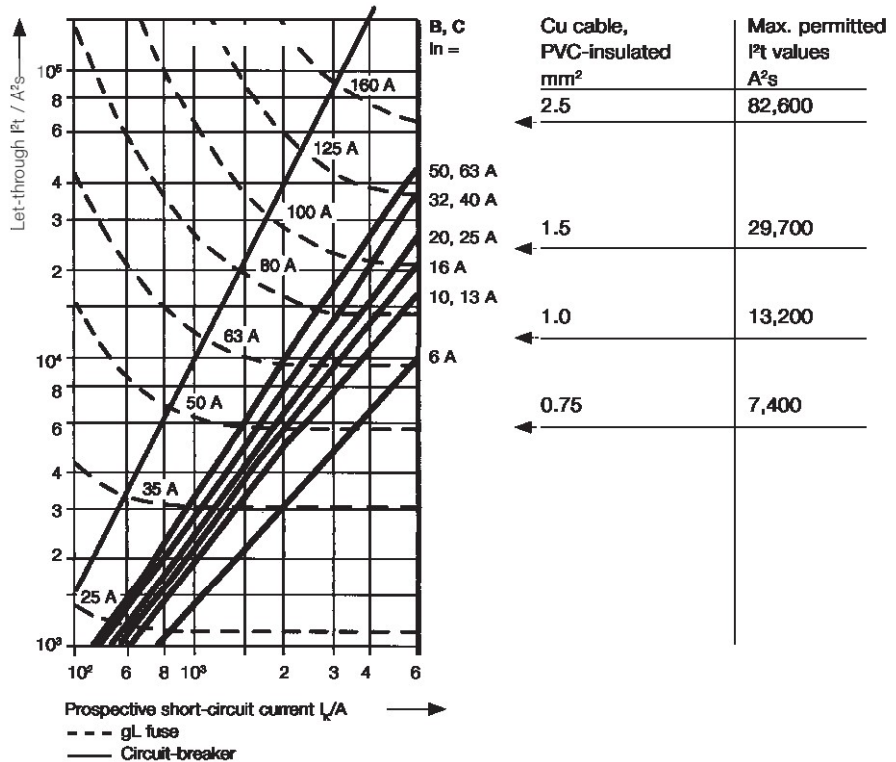
- - - gL fuse
—— Circuit-breaker

Fig. 1 Let.-through energy I²t

Overload protection in accordance with IEC 60364-4-43

For protection against overload, the protective device must be selected based on the current carrying capacity I_z of the cable:

$$I_b \leq I_n \leq I_z \quad (1)$$
$$I_2 \leq 1.45 \times I_z \quad (2)$$

I_b = Design current of a circuit
I_n = Rated current of the protective device
I_z = Current carrying capacity of the cable in accordance with IEC/HD 60364-5-52
I_2 = Current ensuring effective operation in the conventional time of the protective device
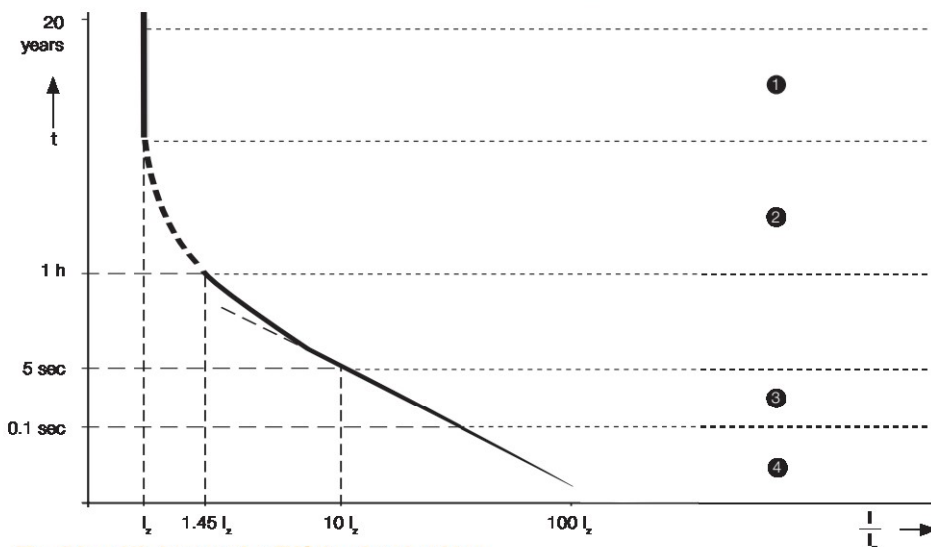

① Area of complete heat dissipation with continuous current I_z
  Permissible operating temperature 70 °C (PVC)

② Area of limited heat dissipation in the event of overload $I_2 \leq 1.45 \times I_z$

③ Area without heat dissipation for a maximum short circuit duration of 5s
  I²t = constant, permissible short circuit temperature 160 °C

④ With a disconnection time of < 0.1s, the I²t of the miniature circuit-breaker must be less than $k^2 \cdot S^2$ of the cable
  (k = material value in accordance with IEC /HD 60364-4-43;
  S = cable cross section in mm²)

Fig. 2 Load limit curve for PVC-insulated cables