

Ny utgave 2010

Vg2 elektro

Teori med
praktiske
øvinger

Kunnskaps-
løftet

Svein Johnsen

Elektriske anlegg

Vg2 elenergi

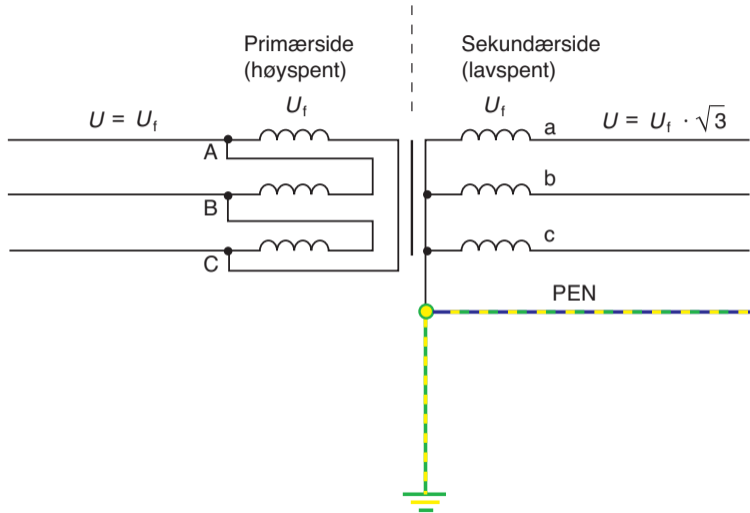
ELFORLAGET

Illustrasjoner til Elektriske anlegg Vg2 elenergi

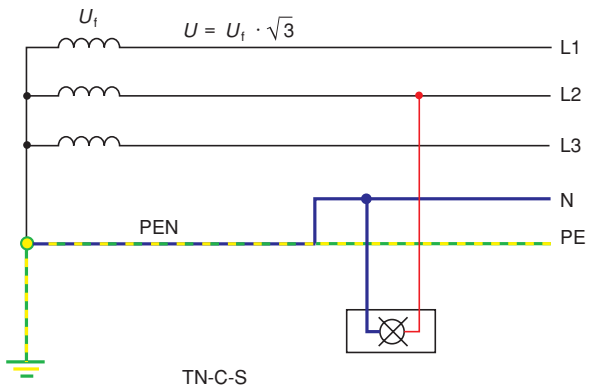
Kapittel 2

Illustrasjonene kan brukes fritt i undervisningen

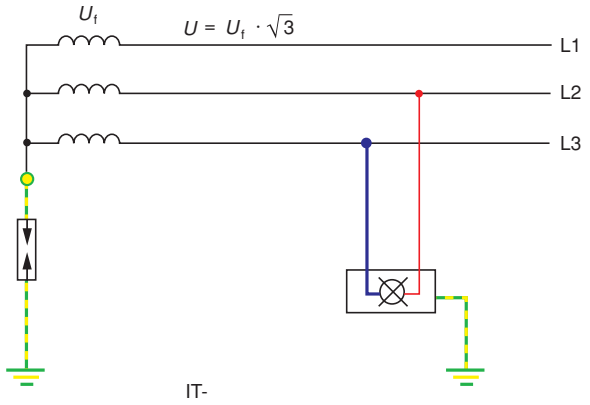
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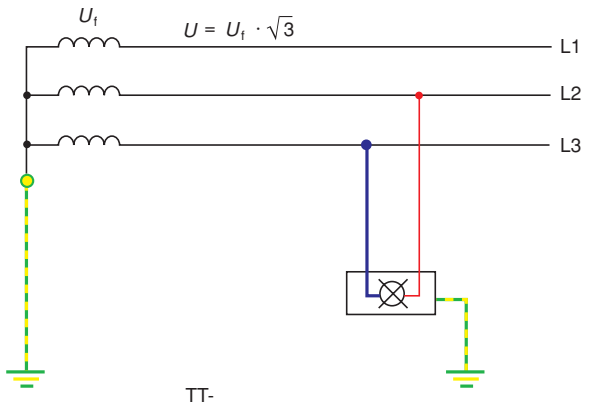
Figur 2.1



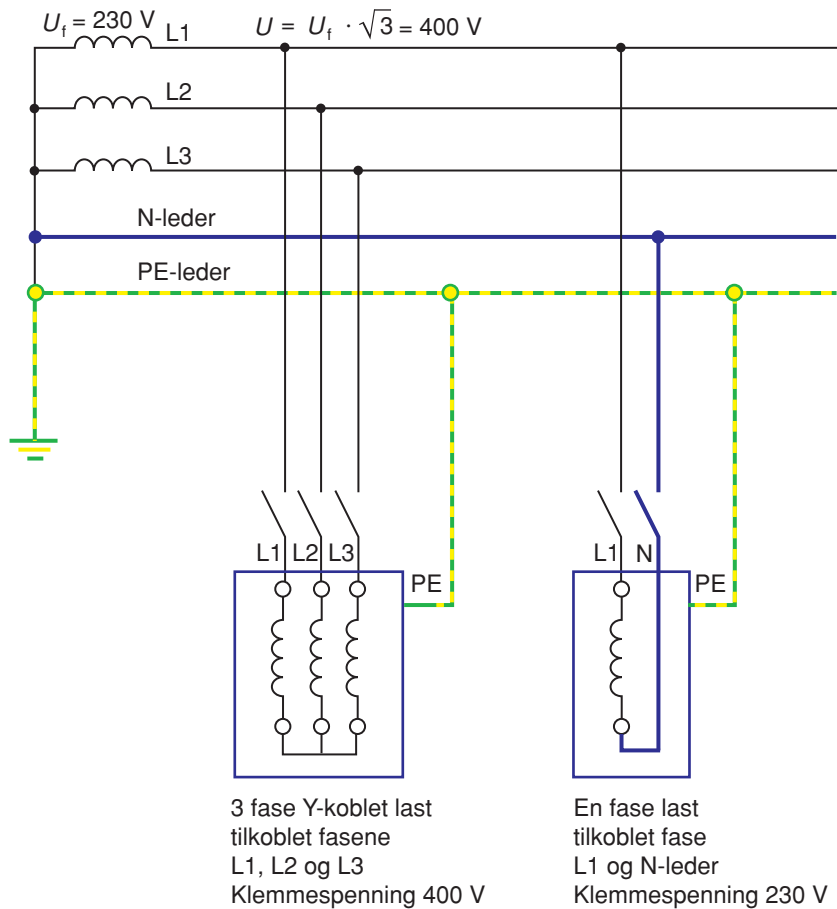
Figur 2.2 a) TN-system



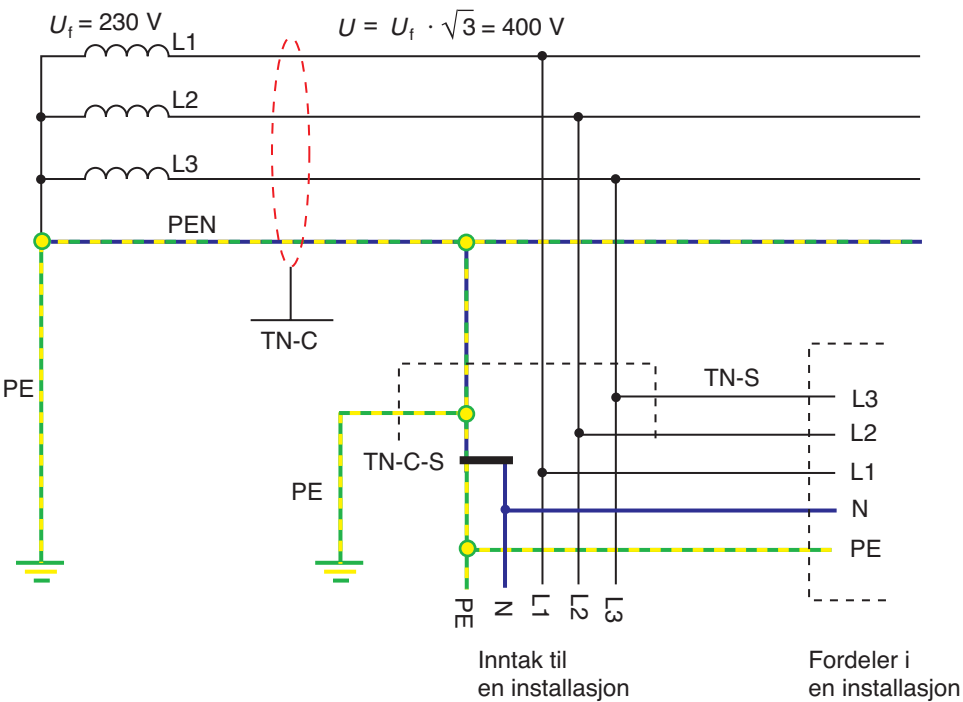
b) IT-system



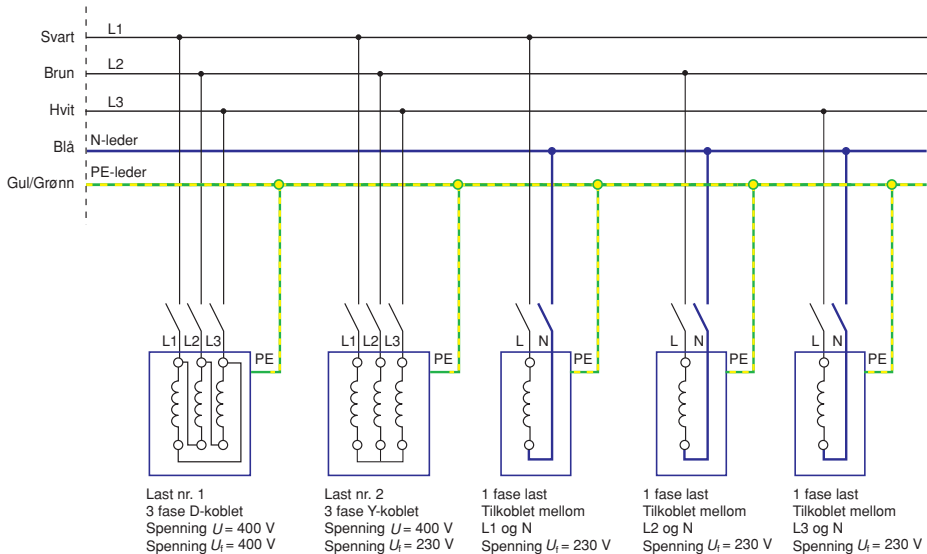
c) TT-system



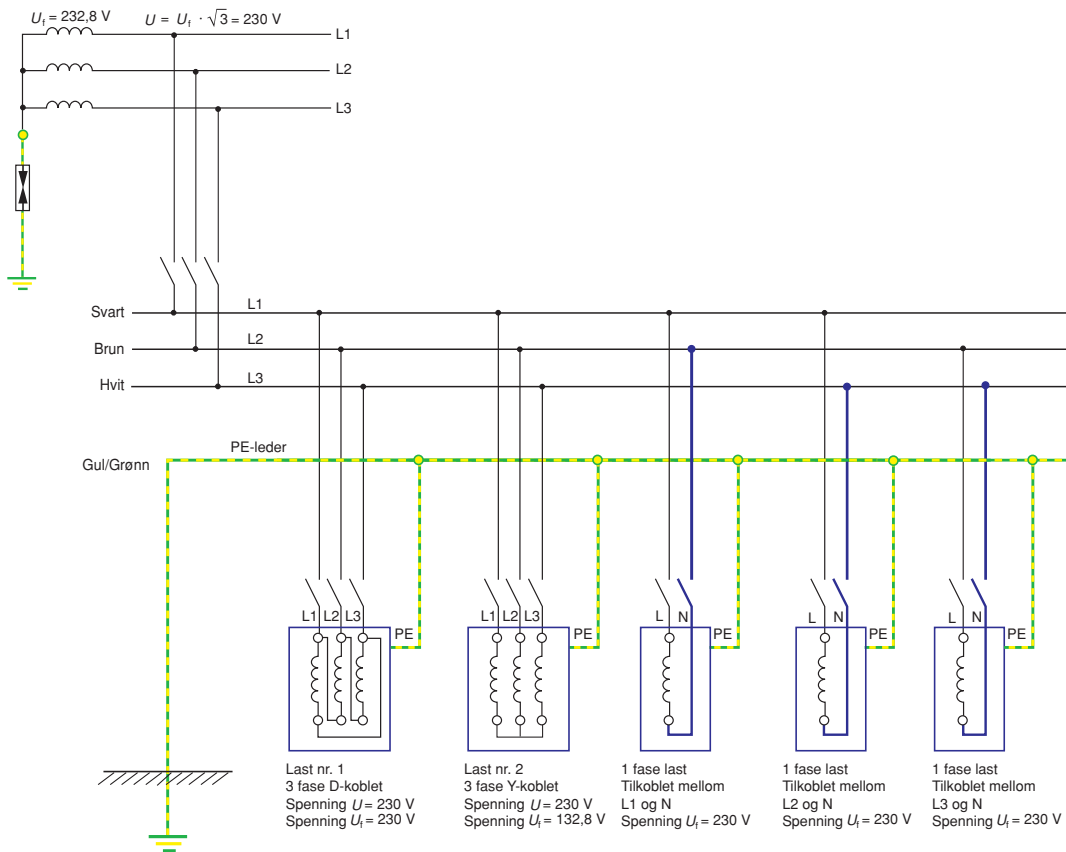
Figur 2.3



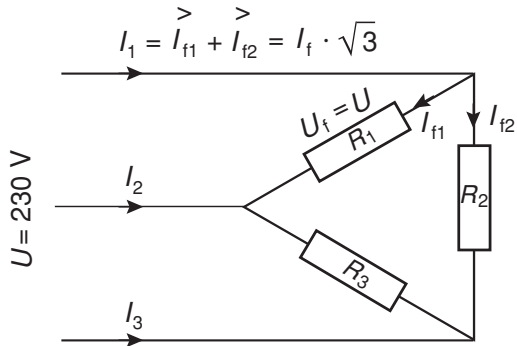
Figur 2.4



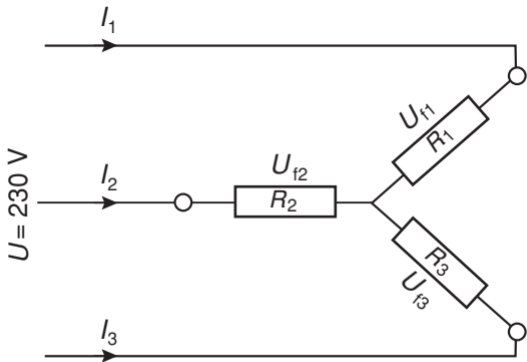
Figur 2.5



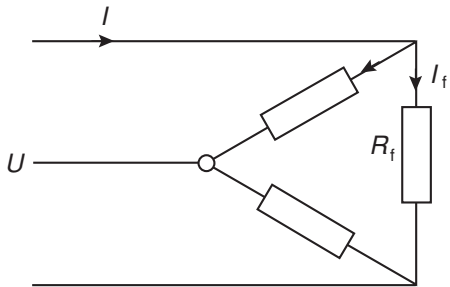
Figur 2.6



Figur 2.7



Figur 2.8



Figur 2.9

$$P_f = U_f \cdot I_f$$

$$P_f = \frac{U_f^2}{R_f}$$

$$I_f = \frac{I}{\sqrt{3}}$$

Faseeffekt $P_f = U \cdot I_f$

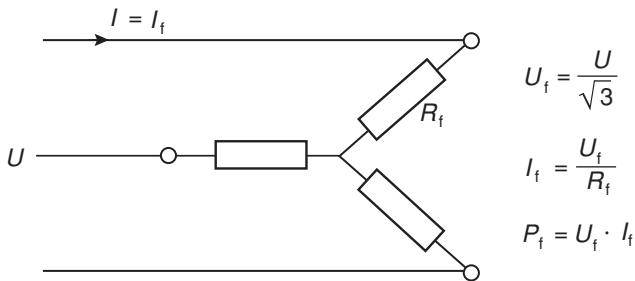
Trefaseeffekt $P_\Delta = 3 \cdot U \cdot I_f$

$$P_\Delta = 3 \cdot U \cdot \frac{I}{\sqrt{3}}$$

$$P_\Delta = \sqrt{3} \cdot U \cdot I$$

Dersom det er reaktiv effekt i belastningen må vi ta med effektfaktor $\cos \varphi$

$$P_\Delta = \sqrt{3} \cdot U \cdot I \cdot \cos \varphi$$

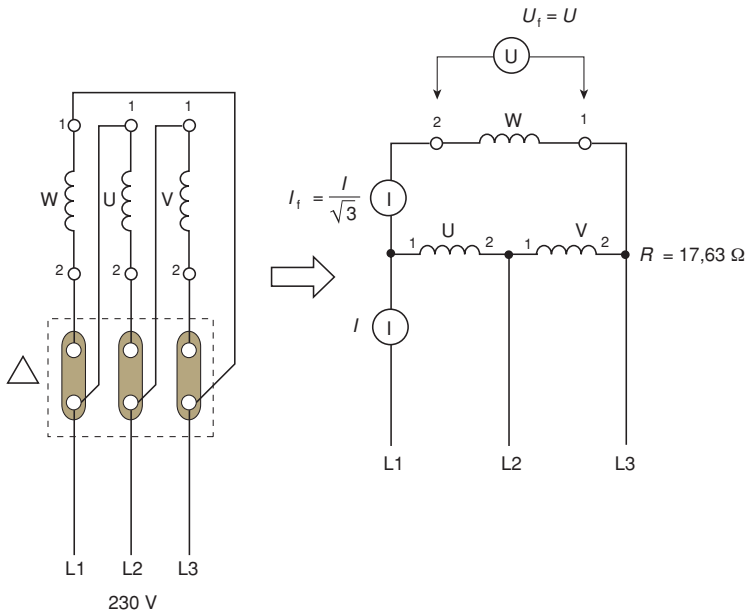


Trefaseeffekt $P_Y = 3 \cdot U_f \cdot I_f$

$$P_Y = 3 \cdot \frac{U}{\sqrt{3}} \cdot I$$

$$P_Y = \sqrt{3} \cdot U \cdot I$$

Figur 2.10



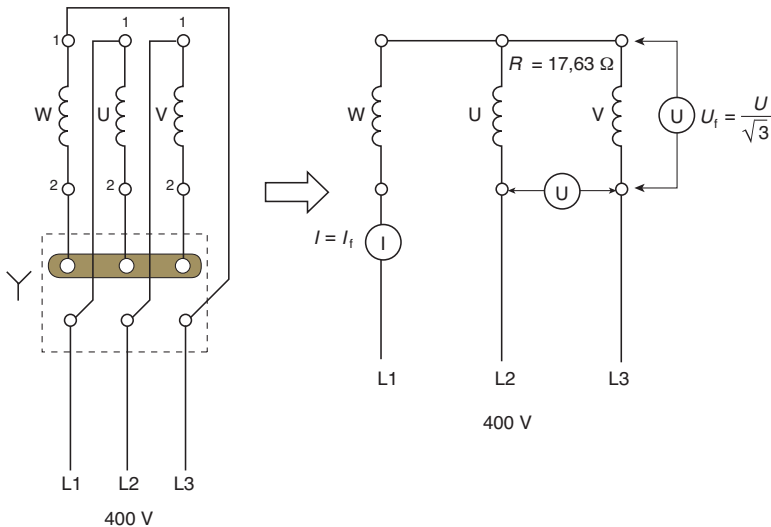
Fasespenning: $U_f = U = \underline{230 \text{ V}}$

Fasestrøm: $I_f = \frac{U_f}{R_f} = \frac{230 \text{ V}}{17,63 \Omega} \approx 13 \text{ A}$

Hovedstrøm: $I = \sqrt{3} \cdot I_f = \sqrt{3} \cdot 13 \text{ A} \approx 22,6 \text{ A}$

Effekt: $P_D = \sqrt{3} \cdot U \cdot I = \sqrt{3} \cdot 230 \text{ V} \cdot 22,6 \text{ A} \approx \underline{9000 \text{ W}}$

Figur 2.11 Trekantkobling til 230 V nettspenning



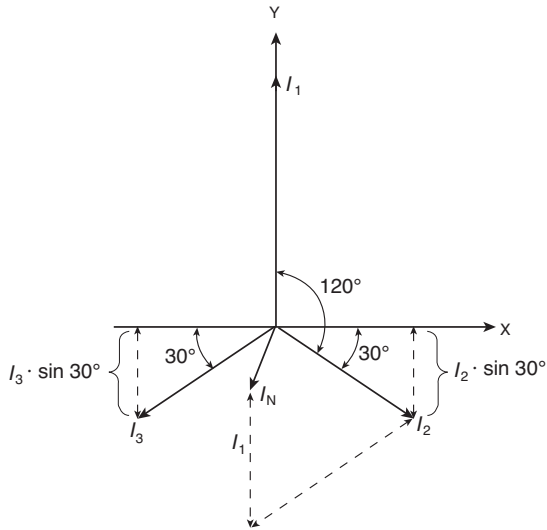
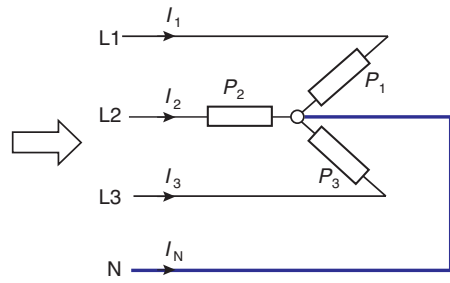
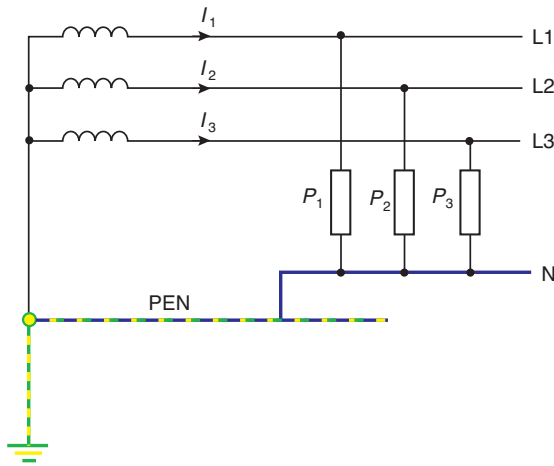
Fasespenning: $U_f = U = \frac{400 \text{ V}}{\sqrt{3}} \approx 230 \text{ V}$

Fasestrøm: $I_f = I = \frac{U_f}{R_f} = \frac{230 \text{ V}}{17,63 \Omega} \approx 13 \text{ A}$

Hovedstrøm: $I = I_f = 13 \text{ A}$

Effekt: $P_Y = \sqrt{3} \cdot U \cdot I = \sqrt{3} \cdot 400 \text{ V} \cdot 13 \text{ A} \approx 9000 \text{ W}$

Figur 2.12 Stjernekobling til 400 V nettspenning



Beregning av strøm i nøytralleder

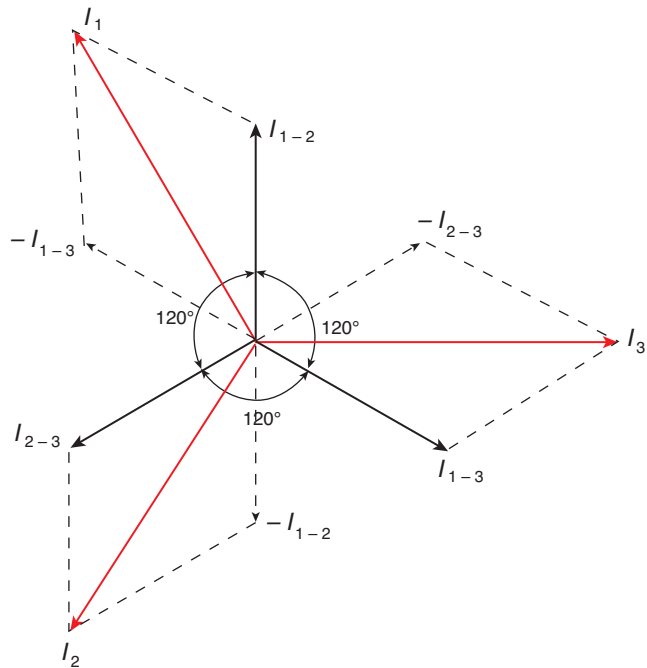
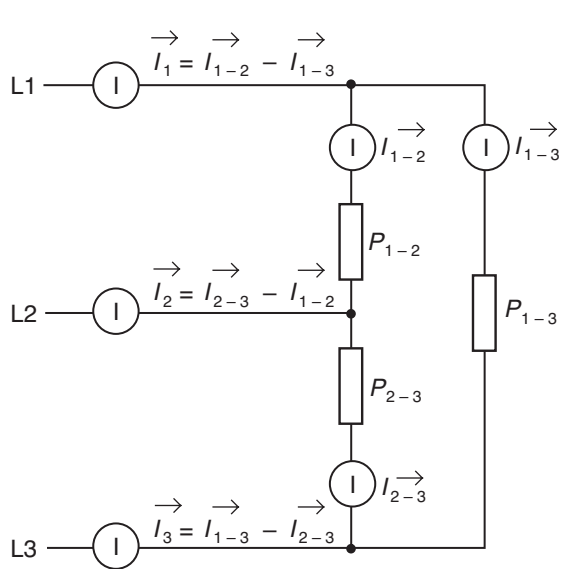
$$\text{Vektorsum } I_y = I_1 - I_2 \cdot \sin 30^\circ - I_3 \cdot \sin 30^\circ = I_1 - \frac{1}{2} I_2 - \frac{1}{2} I_3$$

$$\text{Vektorsum } I_x = I_2 \cdot \cos 30^\circ - I_3 \cdot \cos 30^\circ = \frac{\sqrt{3}}{2} \cdot I_2 - \frac{\sqrt{3}}{2} \cdot I_3$$

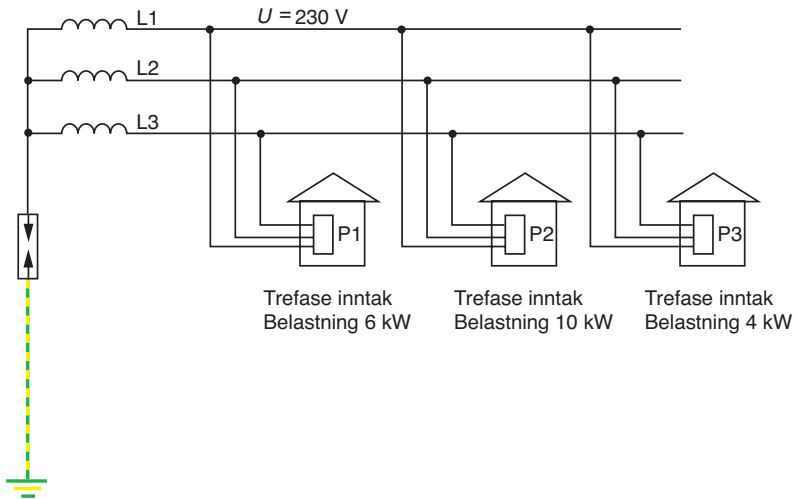
Nøytralstrøm $I_N = \sqrt{I_x^2 + I_y^2}$. Utleidet vil dette bli:

$$I_N = \sqrt{I_1^2 + I_2^2 + I_3^2 - I_1 \cdot I_2 - I_1 \cdot I_3 - I_2 \cdot I_3}$$

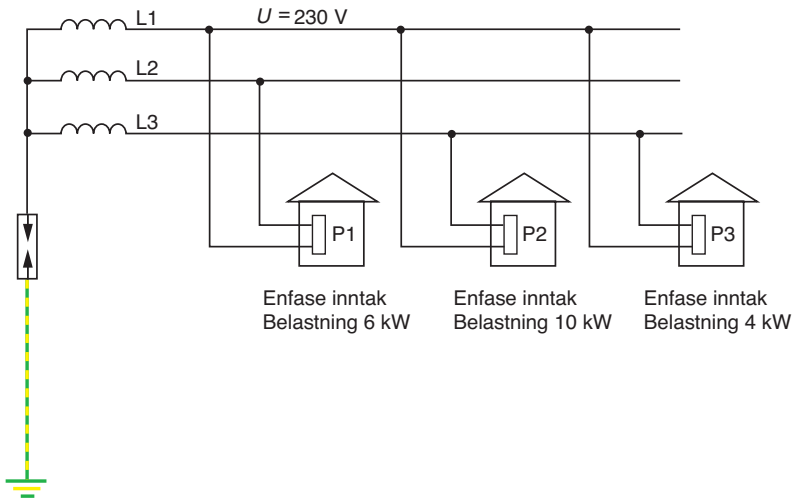
Figur 2.13



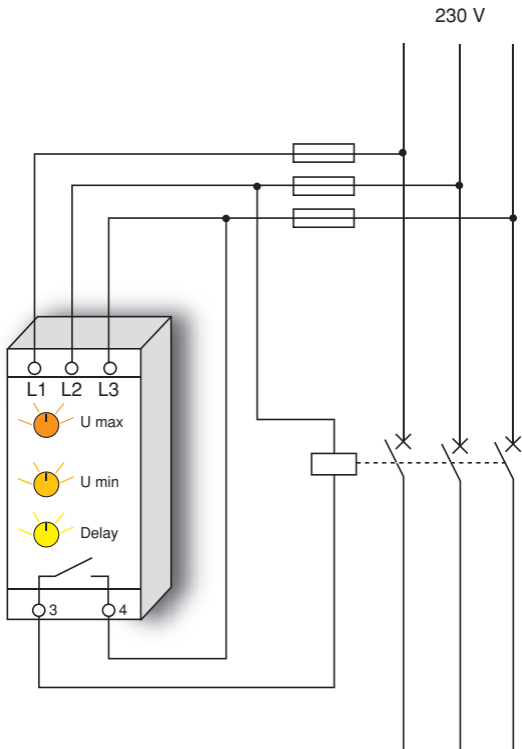
Figur 2.14



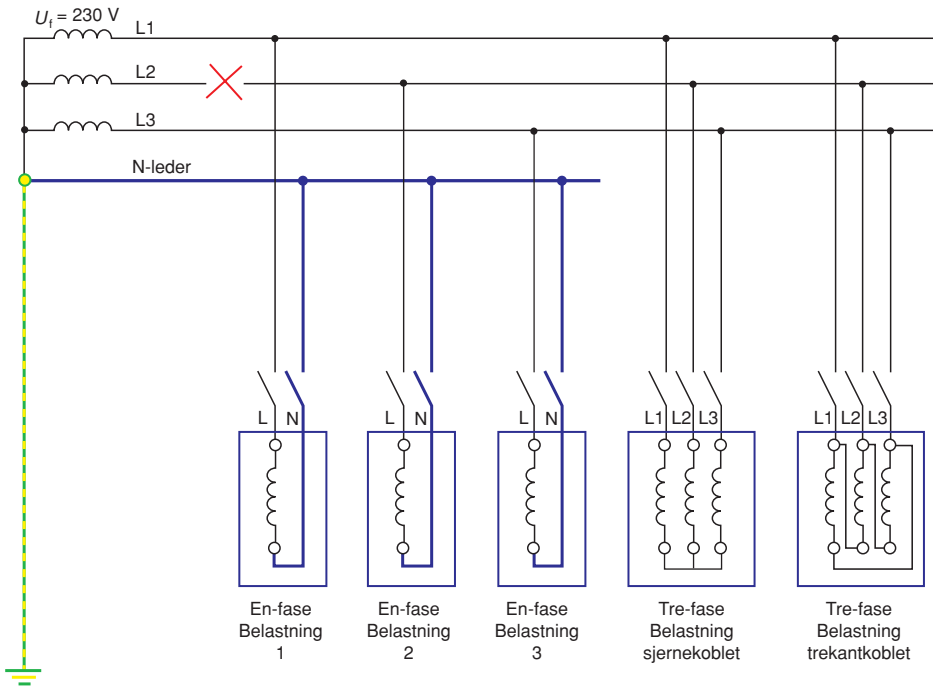
Figur 2.15



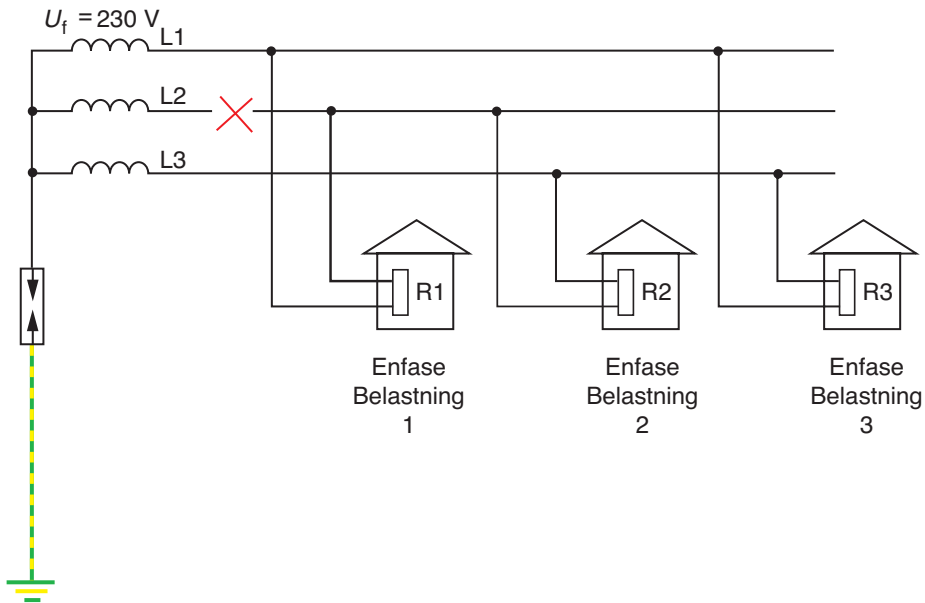
Figur 2.16



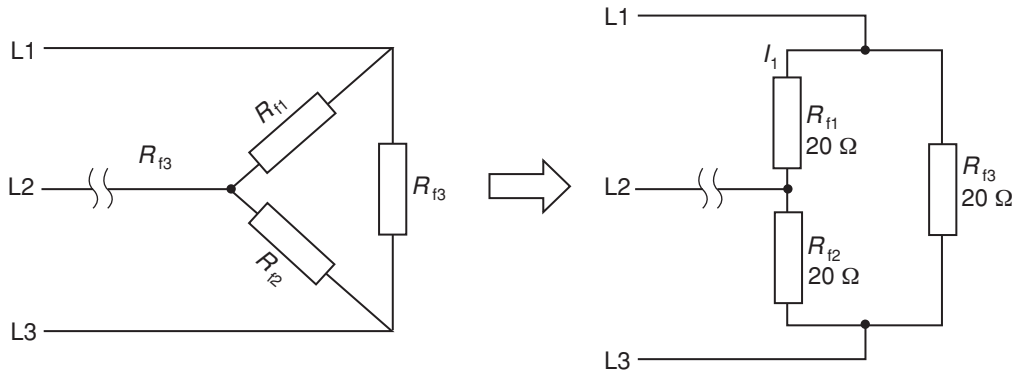
Figur 2.17



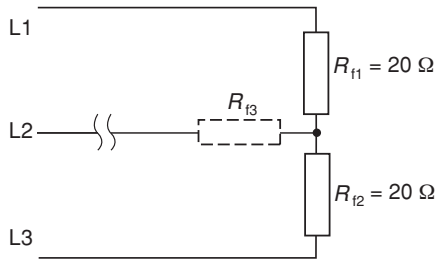
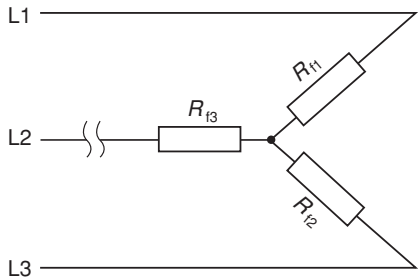
Figur 2.18 Fasebrudd i TN-nett



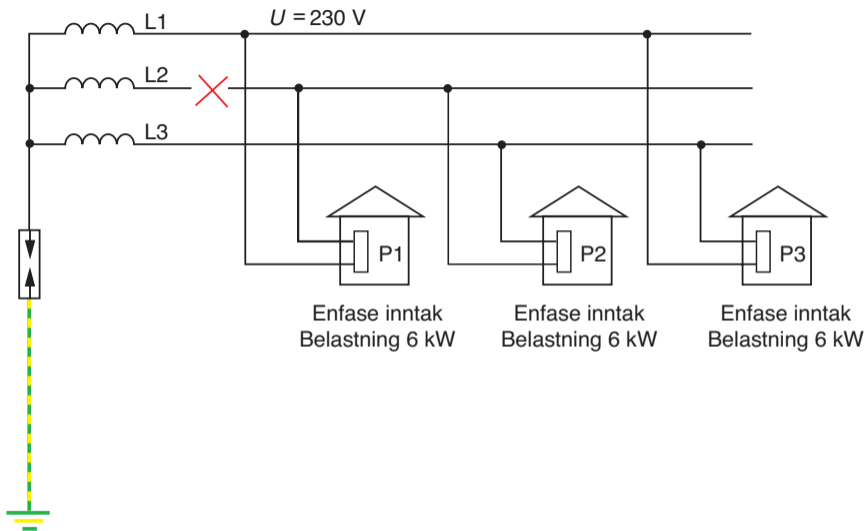
Figur 2.19 Fasebrudd i IT-nett



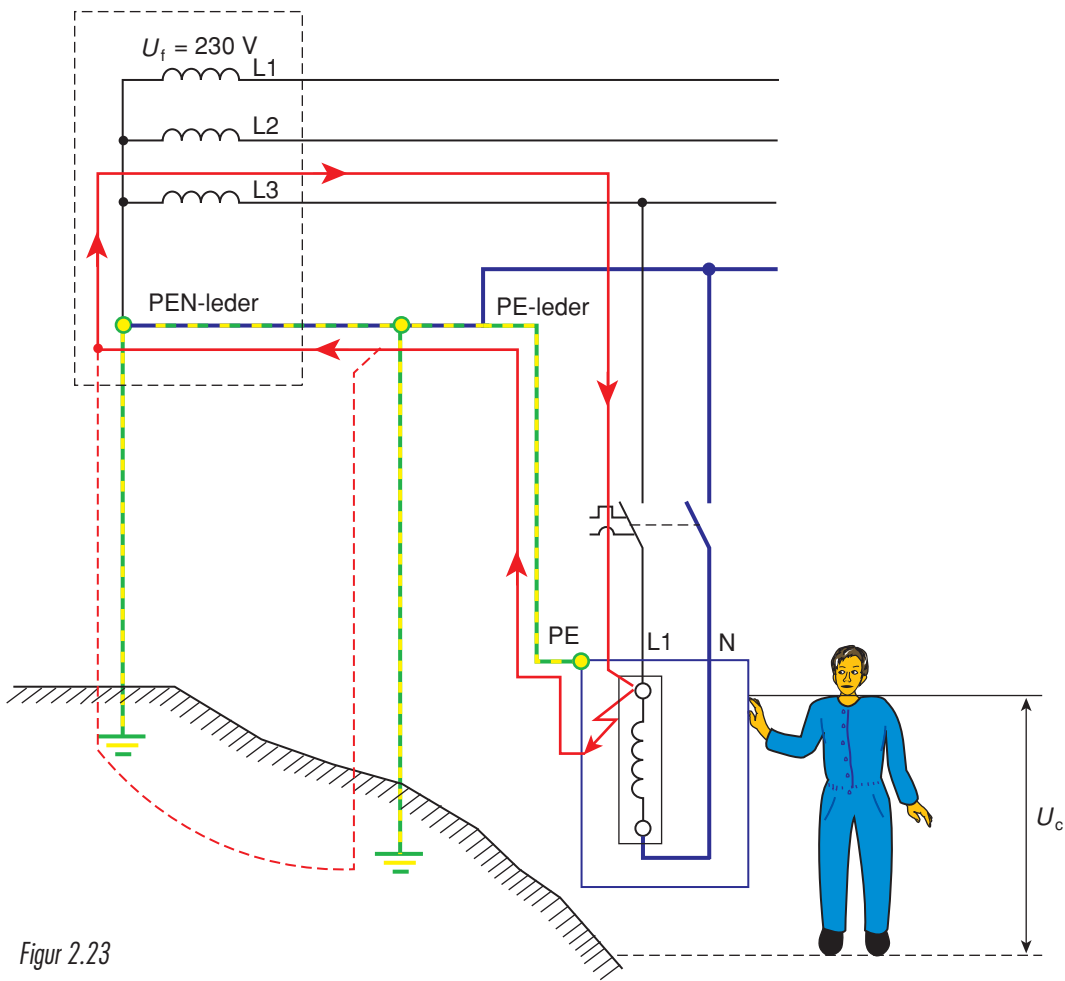
Figur 2.20 Fasebrudd i trekantkobling



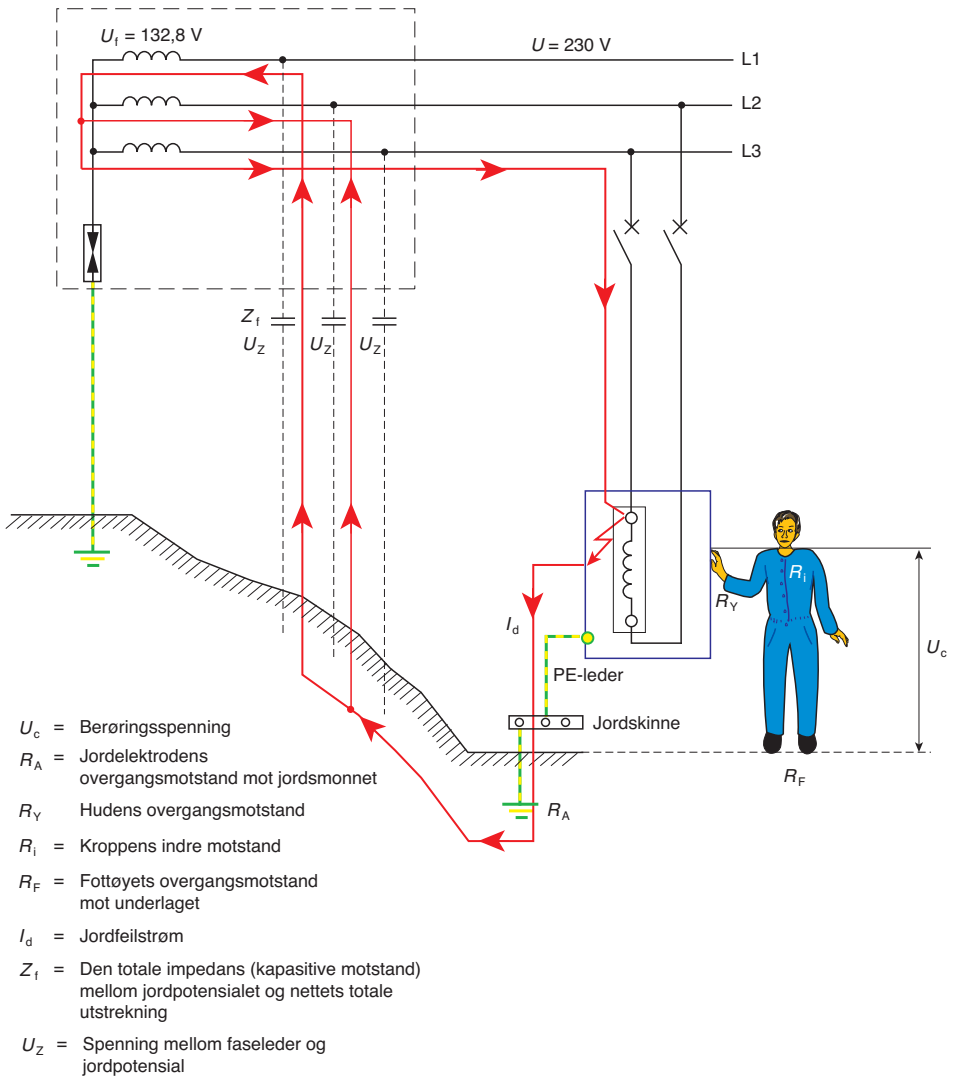
Figur 2.21 Fasebrudd i stjernekobling



Figur 2.22



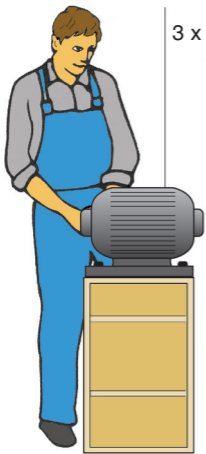
Figur 2.23



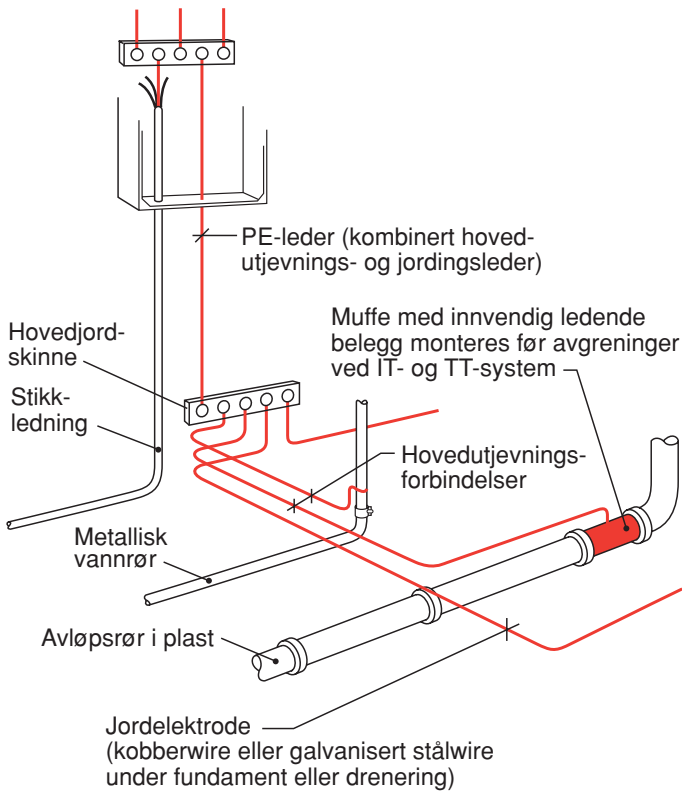
Figur 2.24

3 x 230 V

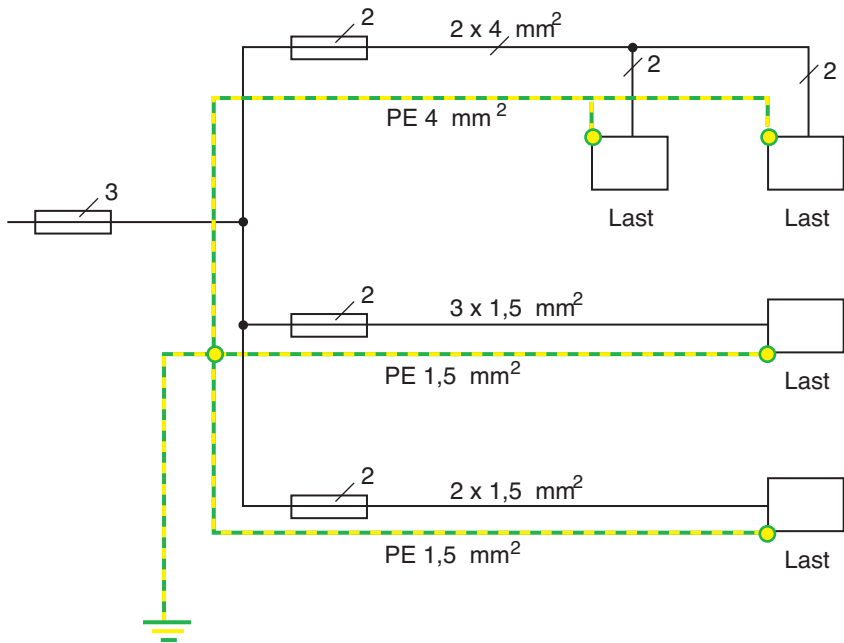
3 x 2,5 mm²/2,5 mm²



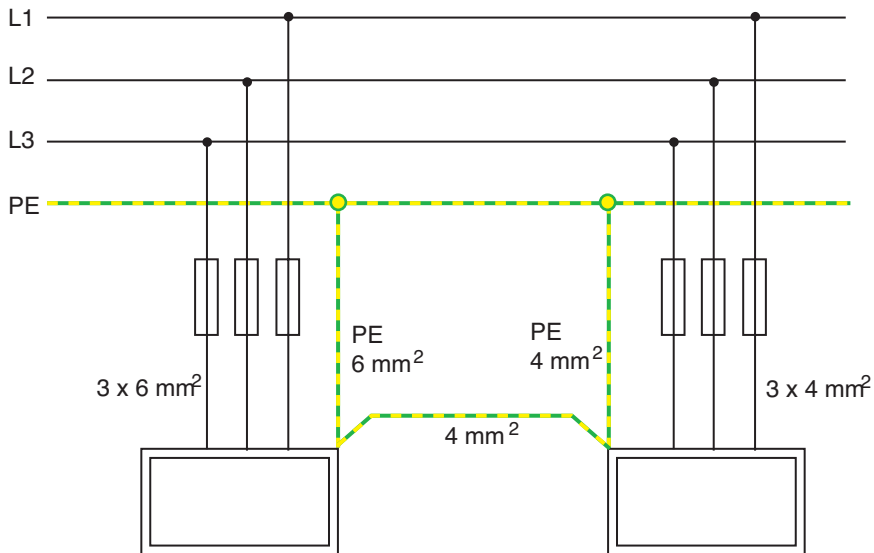
Figur 2.25



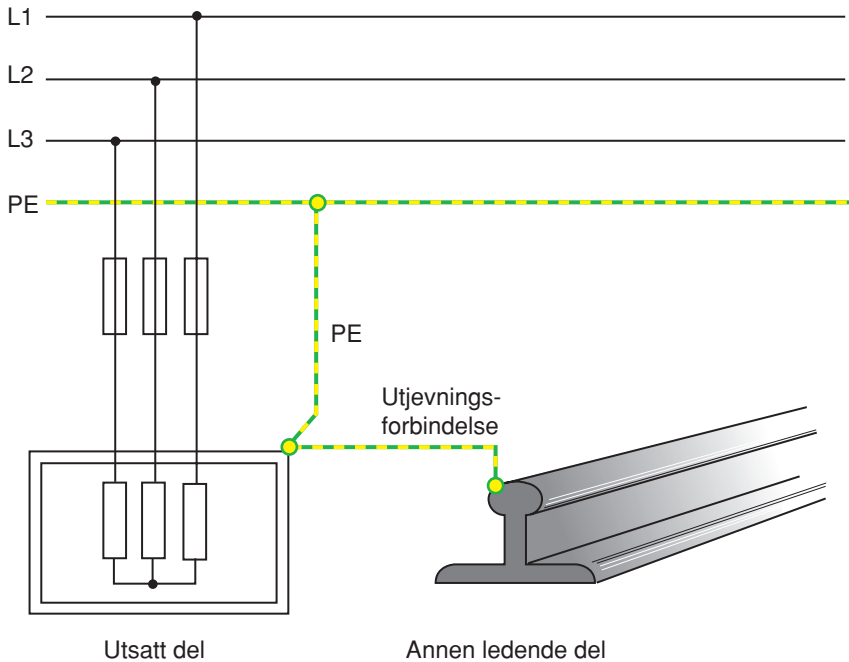
Figur 2.26 Beskyttelsesjording



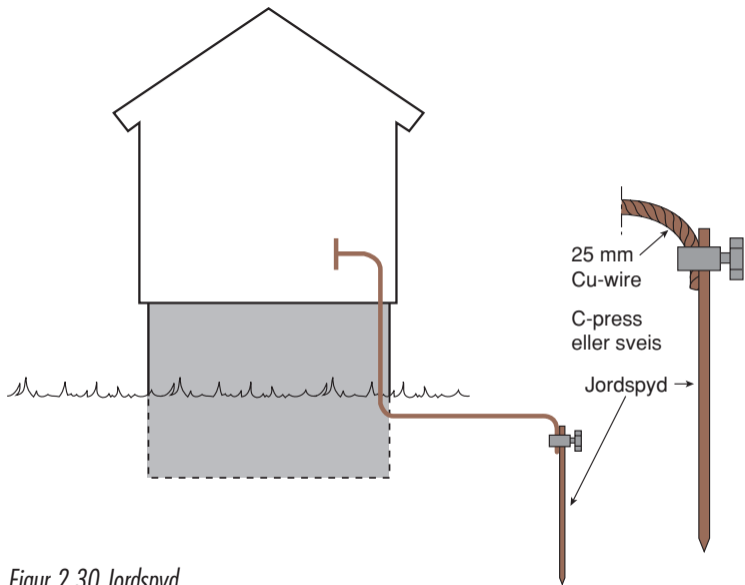
Figur 2.27



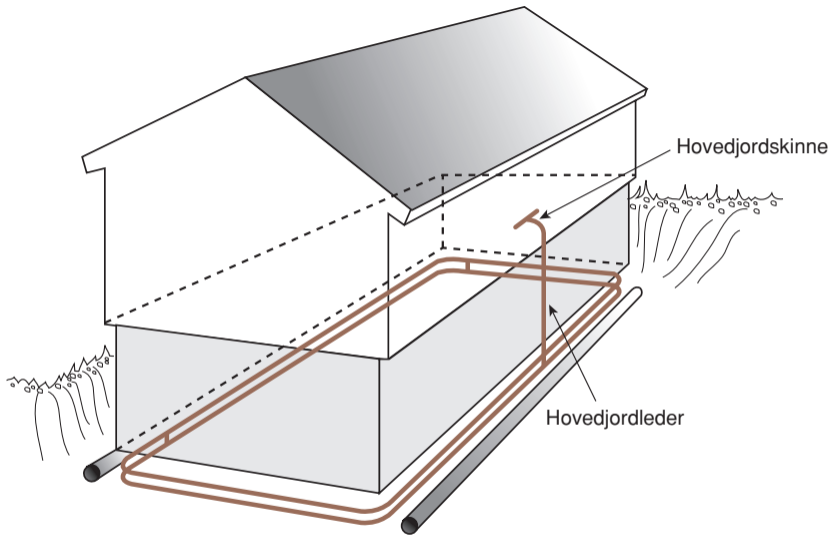
Figur 2.28



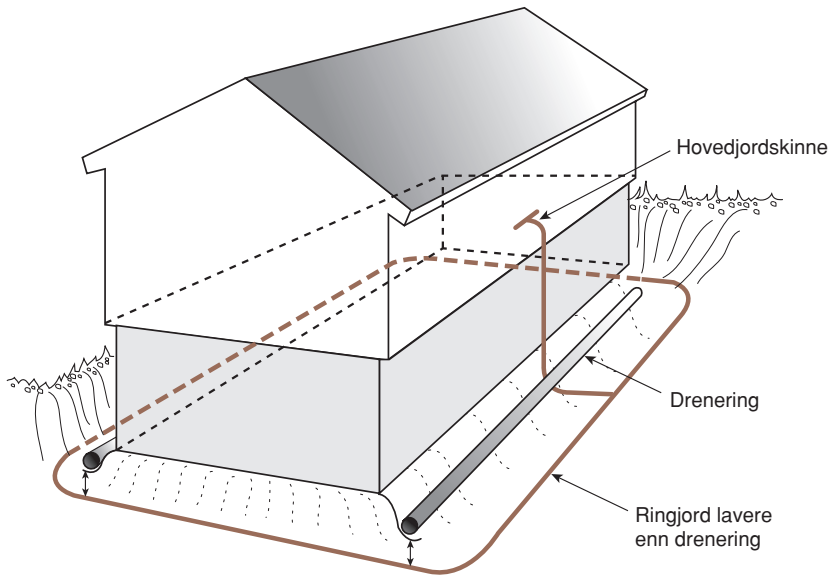
Figur 2.29



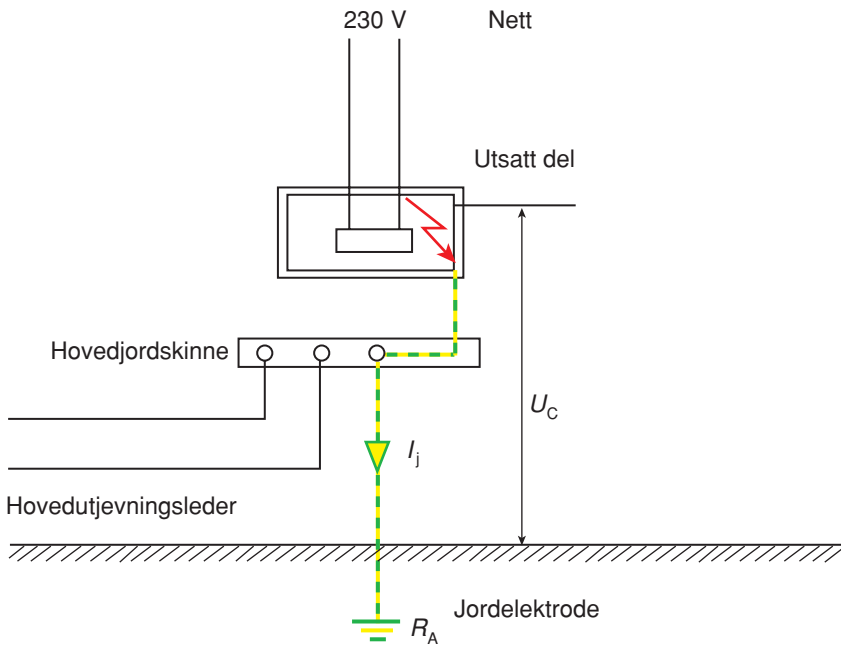
Figur 2.30 Jordspyd



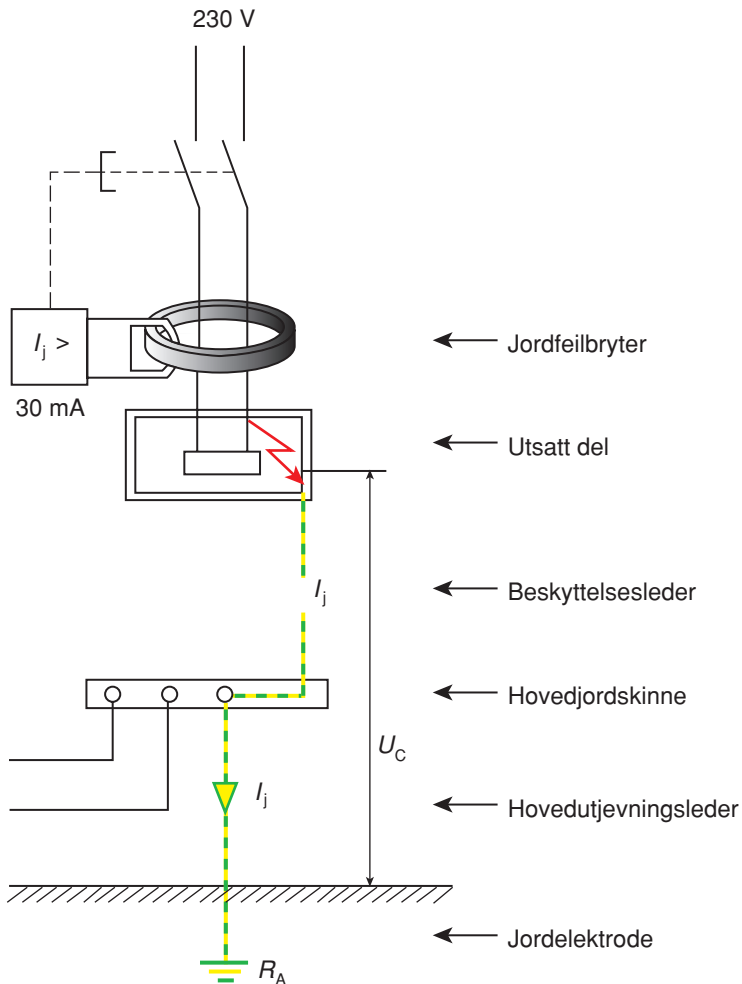
Figur 2.31 Fundamentjord



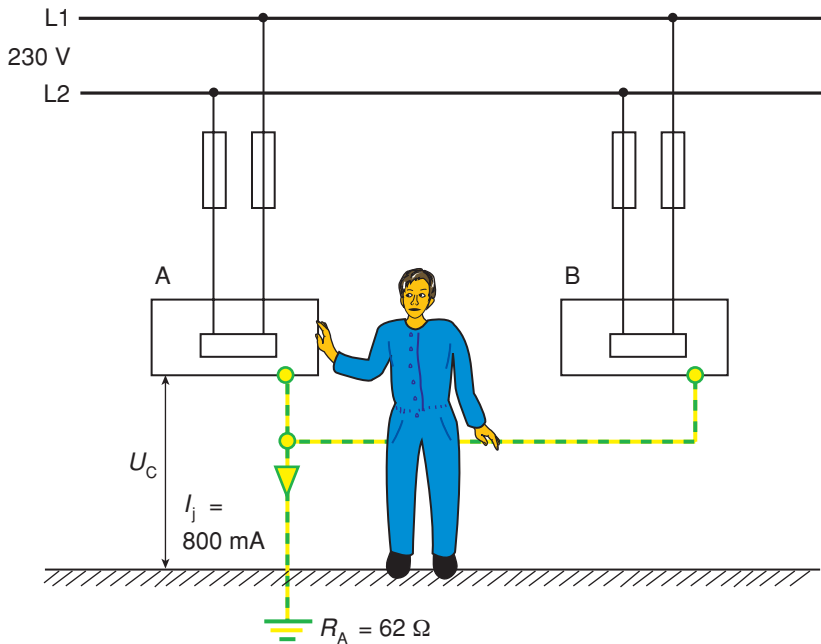
Figur 2.32 Ringjord



Figur 2.33 Beregning av overgangsmotstand R_A ved jordfeilstrom på 1,5 A



Figur 2.34 Beregning av overgangsmotstand R_A dersom anlegget har jordfeilbryter



Figur 2.35