# Sequence Networks: Per-Phase Representation of a Balanced Three-phase representation

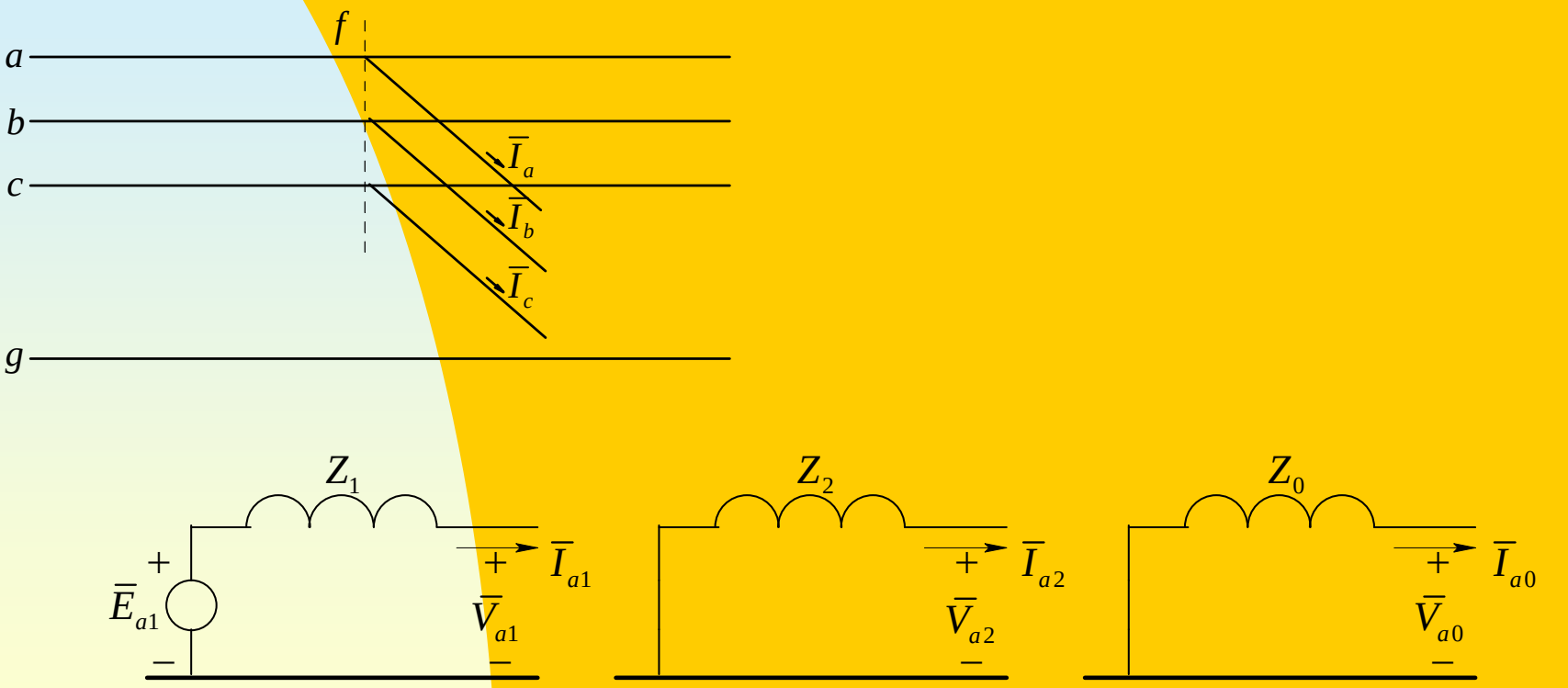



Fig. 13-3 Sequence networks.

# TYPES OF FAULTS

- Symmetrical Three-Phase and Three-Phase to Ground Fault
- Single-Line to Ground Fault
- Double-line to Ground Fault
- Double Line Fault (ground is not involved)
- Fault with Fault Impedances
- open-circuit conductor(s)

# Three-Phase Symmetrical Fault (ground may or may no be involved)

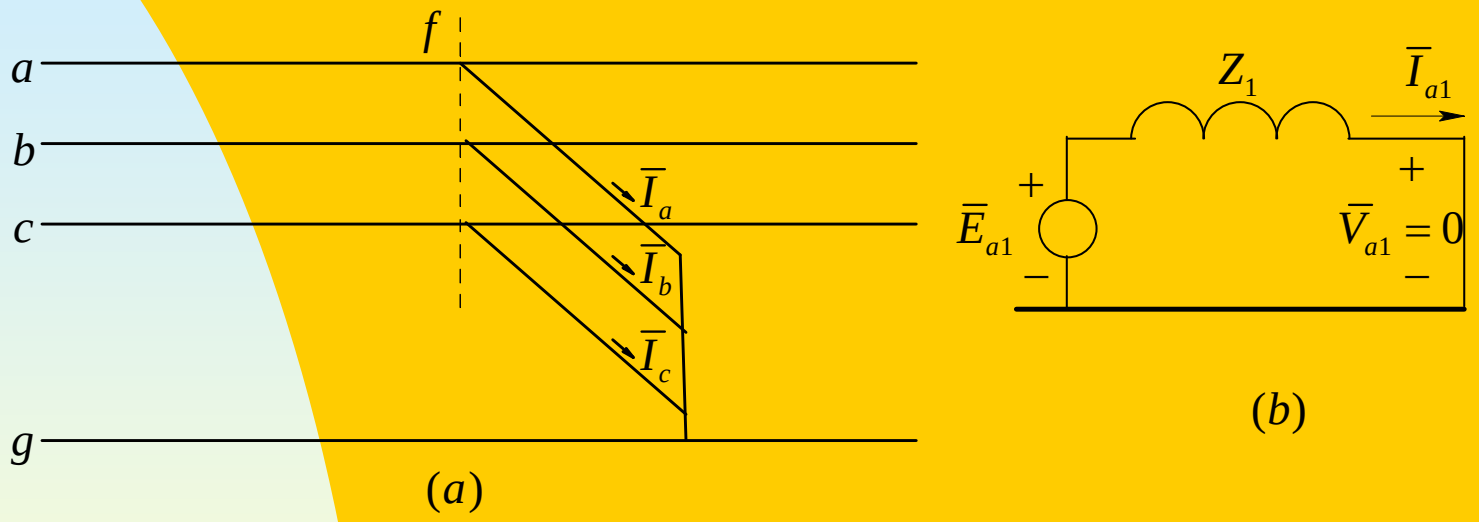



Fig. 13-4 Three-phase symmetrical fault.

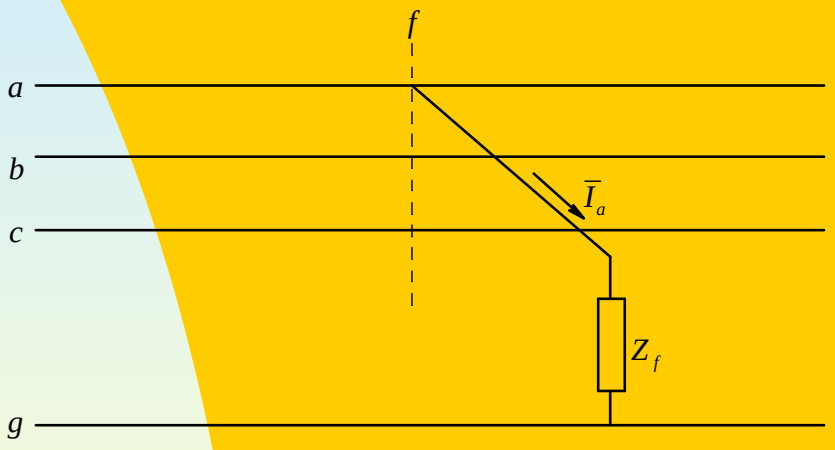
$$\bar{I}_a = \bar{I}_{a1}$$

# Single-Line to Ground (SLF) Fault through a Fault Impedance

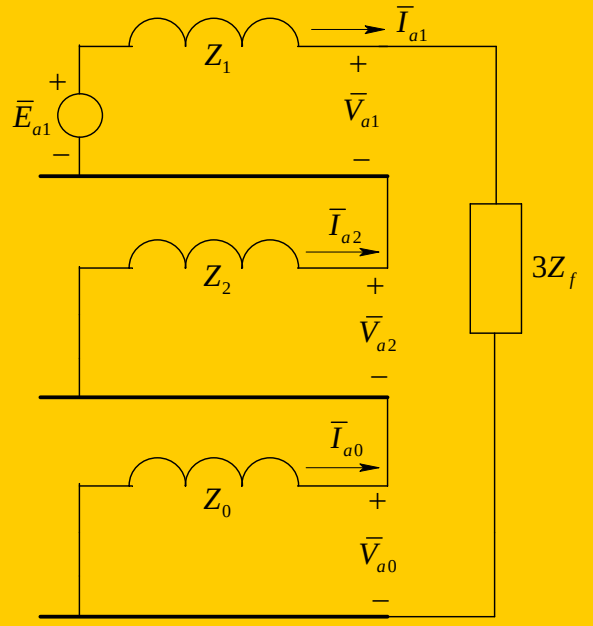
$$\bar{I}_b = \bar{I}_c = 0$$

$$\bar{I}_{a1} = \bar{I}_{a2} = \bar{I}_{a0}$$

$$\bar{I}_{a1} = \frac{\bar{I}_a}{3}$$




(a)




(b)

$$\bar{V}_a = \bar{V}_{a1} + \bar{V}_{a2} + \bar{V}_{a0} = Z_f \bar{I}_a$$

$$\bar{V}_a = \bar{V}_{a1} + \bar{V}_{a2} + \bar{V}_{a0} = 3Z_f \bar{I}_{a1}$$

$$\bar{I}_{a1} = \bar{I}_{a2} = \bar{I}_{a0} = \frac{\bar{E}_{a1}}{Z_1 + Z_2 + Z_0 + 3Z_f}$$

$$\bar{I}_a = 0$$

$$\bar{V}_b = \bar{V}_c = 0$$

$$\bar{V}_{a1} = \bar{V}_{a2} = \bar{V}_{ao}$$

# Double-Line to Ground Fault

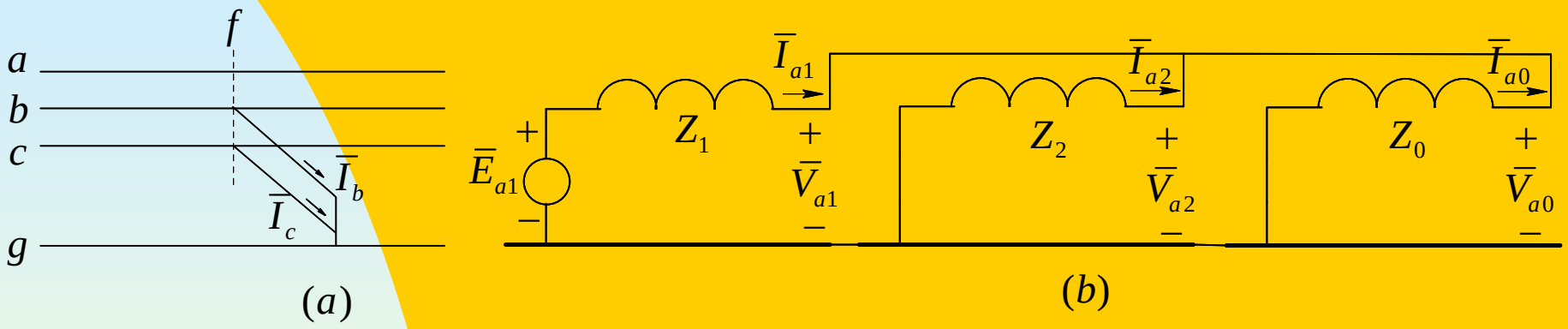



Fig. 13-6 Double line to ground fault.

# Double-Line Fault (ground not involved)

$$\bar{I}_a = 0$$

$$\bar{I}_b = -\bar{I}_c$$

$$\bar{V}_b = \bar{V}_c + Z_f \bar{I}_b$$

$$\bar{I}_{a0} = 0$$

$$\bar{V}_{a0} = 0$$

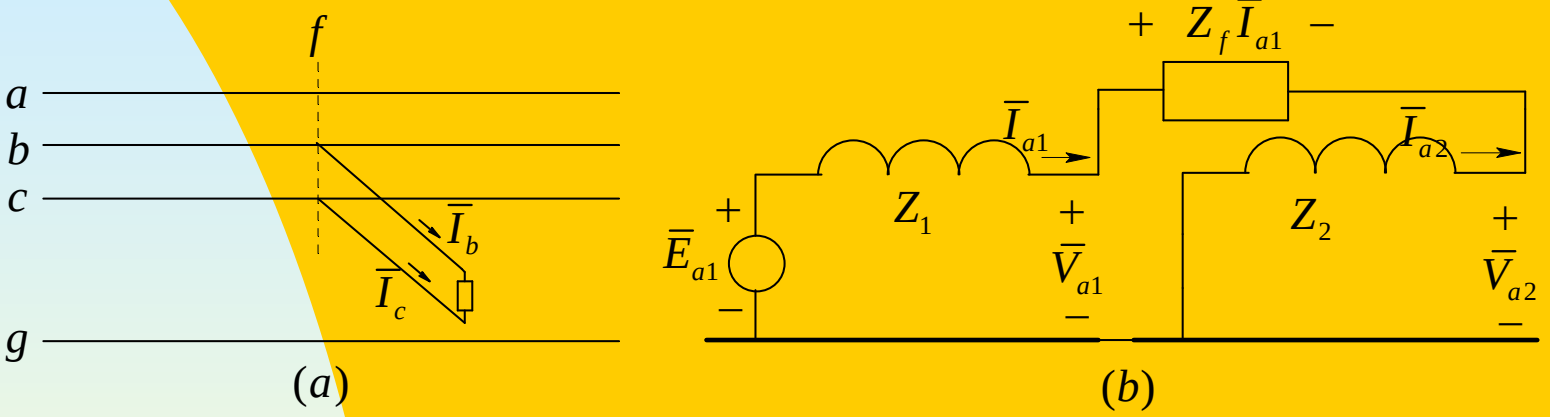



Fig. 13-7 Double line fault (ground not involved).

$$\bar{I}_{a1} = -\bar{I}_{a2}$$

$$\bar{I}_b = (a^2 - a)\bar{I}_{a1}$$

$$a^2\bar{V}_{a1} + a\bar{V}_{a2} = a\bar{V}_{a1} + a^2\bar{V}_{a2} + Z_f(a^2 - a)\bar{I}_{a1}$$

$$\bar{V}_{a1} = \bar{V}_{a2} + Z_f \bar{I}_{a1}$$