Auto-Transformer and Tap-Changing

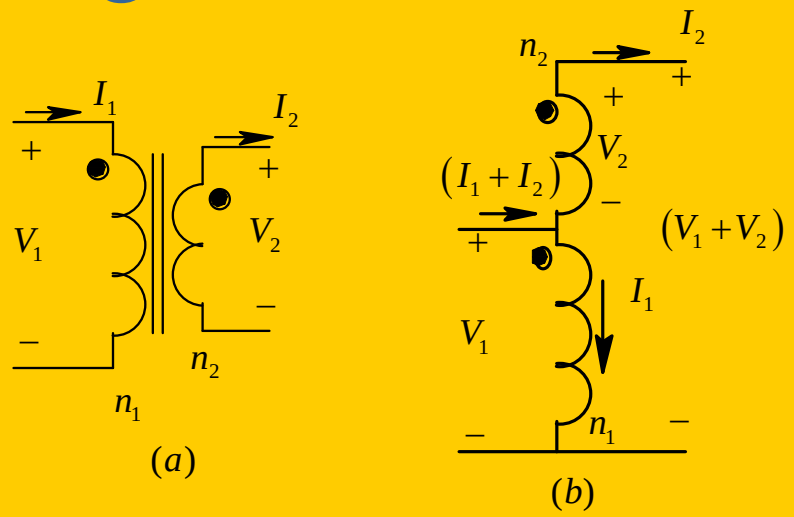


Fig. 6-12 Auto-transformer.

Two-Winding Transformer Rating $= V_1 I_1 = V_2 I_2$

Auto-Transformer Capability $= (V_1 + V_2) I_2$

Auto-Transformer Capability $= \left(1 + \frac{V_1}{V_2}\right)$ × Two-Winding Transformer Rating

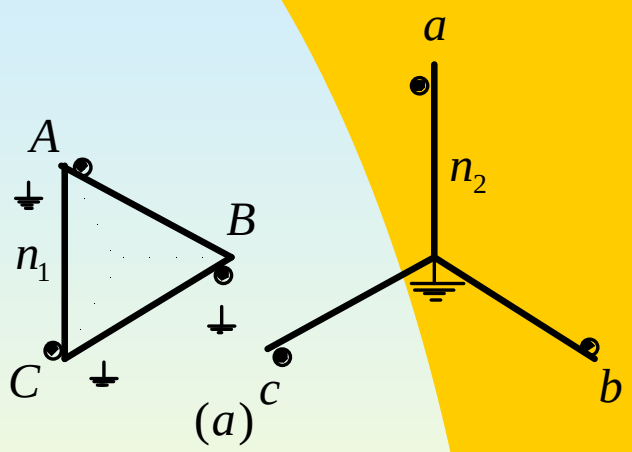
Auto-Transformer Rating $= \left(1 - \frac{V_L}{V_H}\right)$ × System VA Transfer Requirement

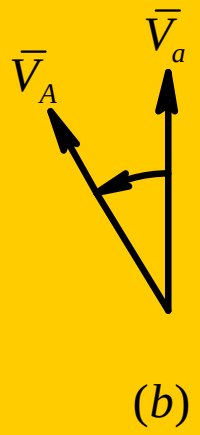
Auto Transformer Example

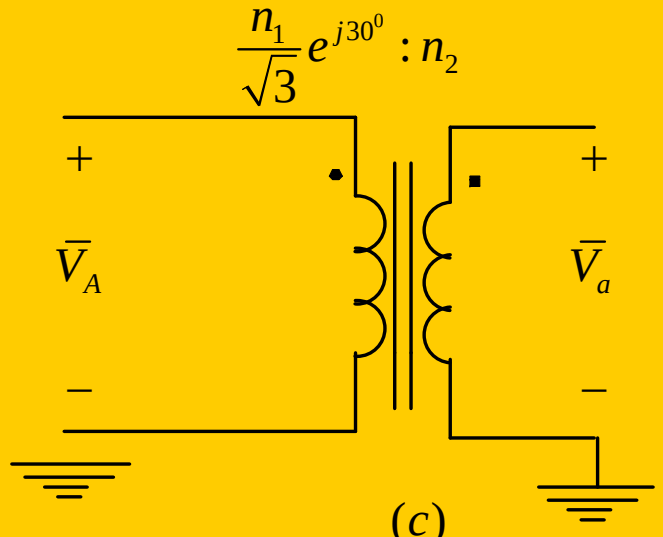
▲ **Example 6-2** In a system, 1 MVA have to be transferred with the low-side voltage of 22 kV and the high-side voltage of 33 kV. Calculate the kVA rating of an auto-transformer to satisfy these requirements.

Solution From Eq. 6-51, the auto-transformer rating is 333 kVA. ▲

Phase-Shift Due to Wye-Delta Transformers



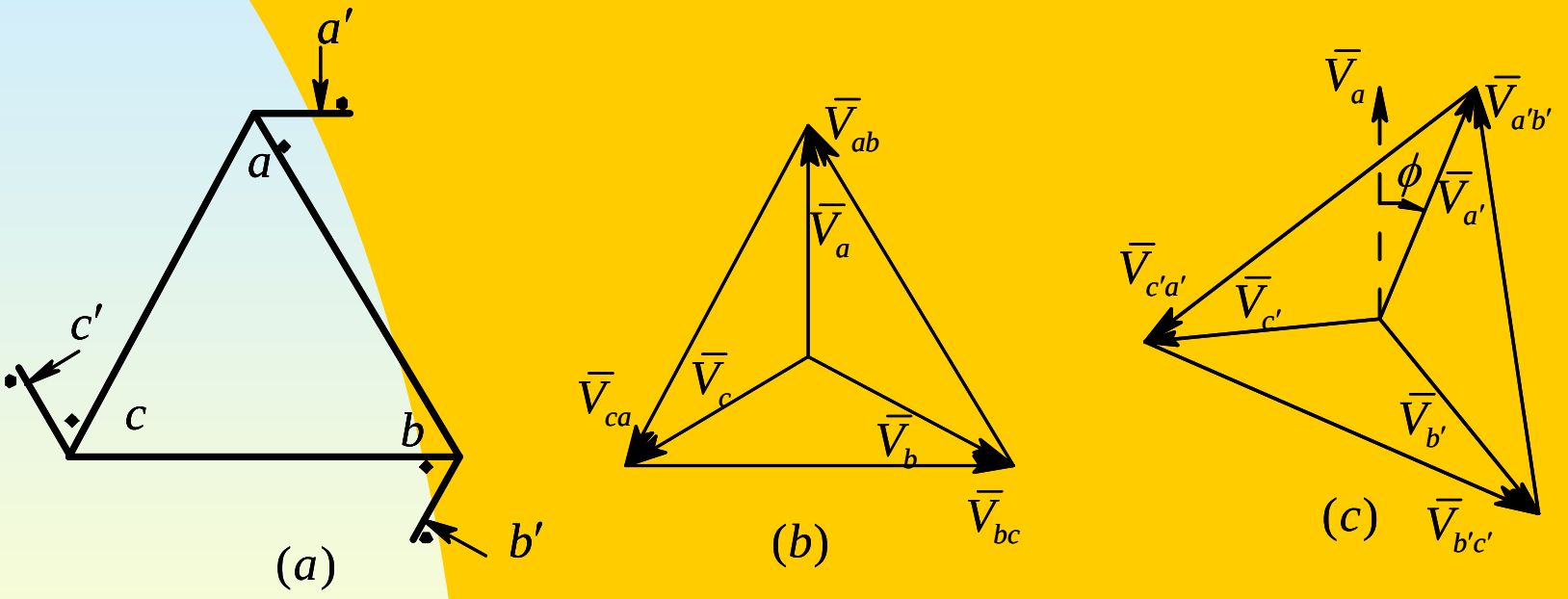




$$V_{AC} = \frac{n_1}{n_2} V_a$$

$$V_A = \frac{1}{\sqrt{3}} \frac{n_1}{n_2} V_a$$

Phase-Shift Control by Transformers



Three-Winding Auto-Transformers

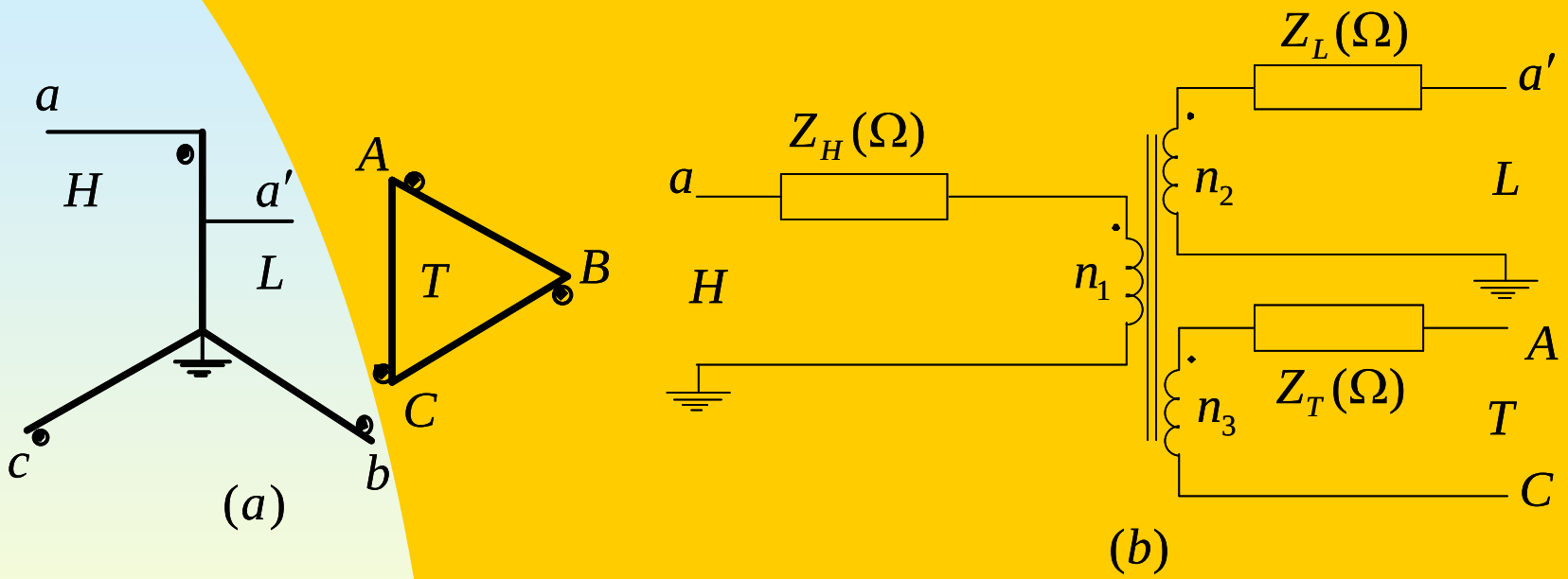


Fig. 6-15 Three-winding auto-transformer.

PU Representation of Off-Nominal Turns-Ratio Transformers

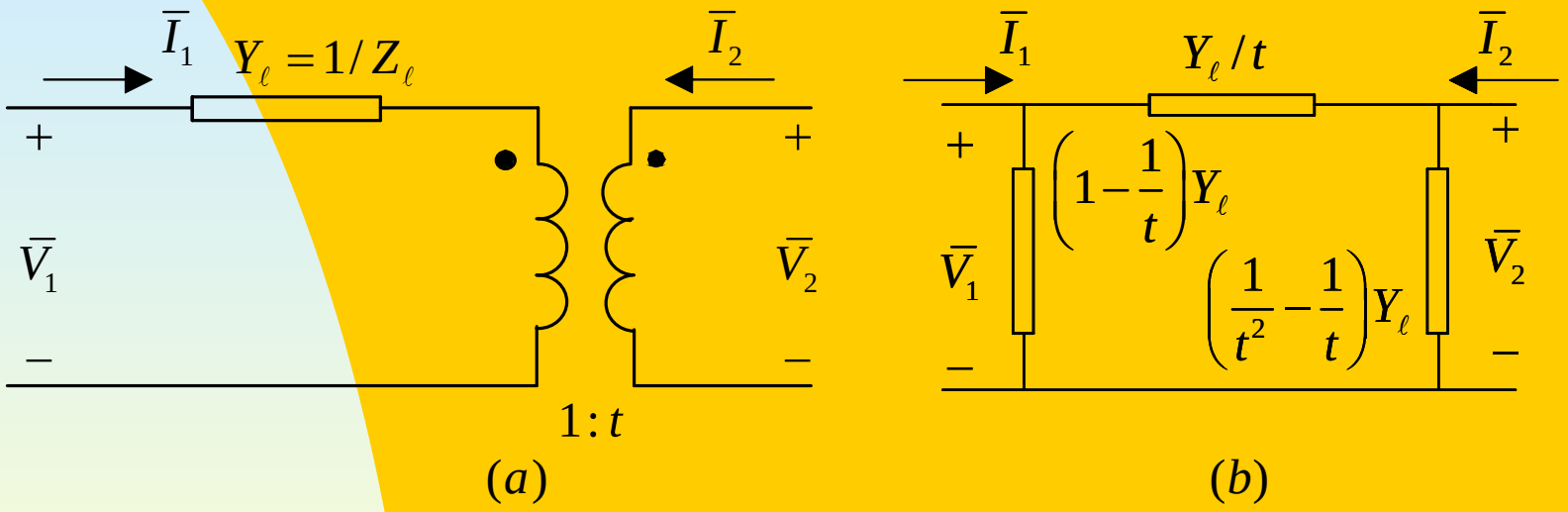


Fig. 6-17 Transformer with an off-nominal turns-ratio or taps in per unit; t is real.

Summary

- Need for Transformers
- Basic Principle of Operation
- Transferring of Leakage Inductances
- Per-Unit Representation
- Efficiencies and Reactances
- Regulation
- Auto-Transformers and Tap-Changing
- Phase-Shift and Phase-Angle Control
- Three-Winding Transformers
- Representation of Off-Nominal Turn Transformers