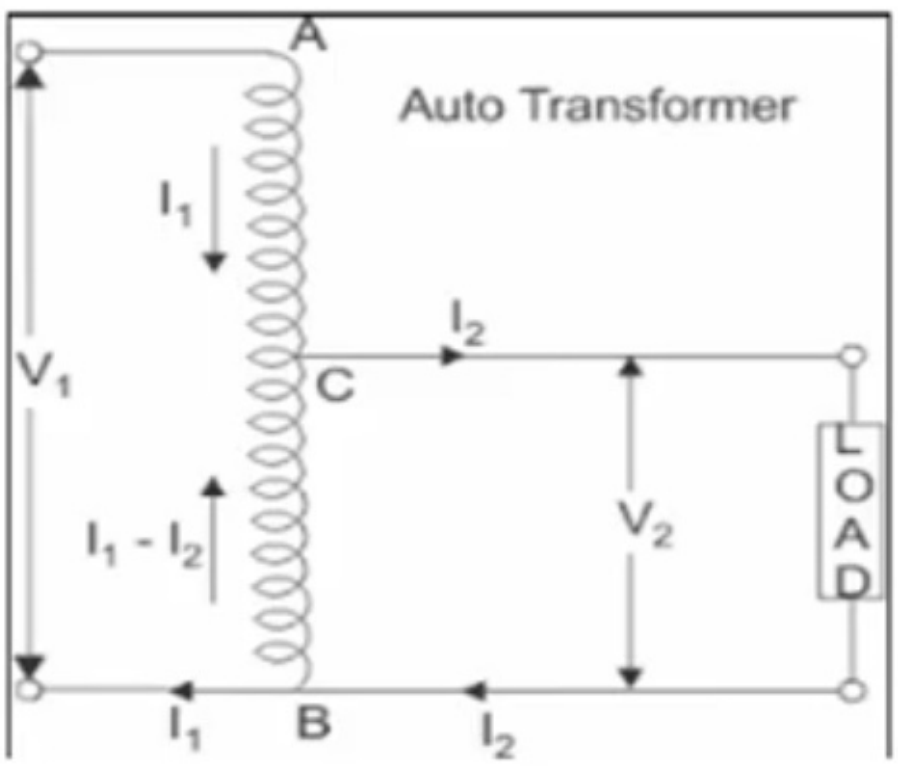
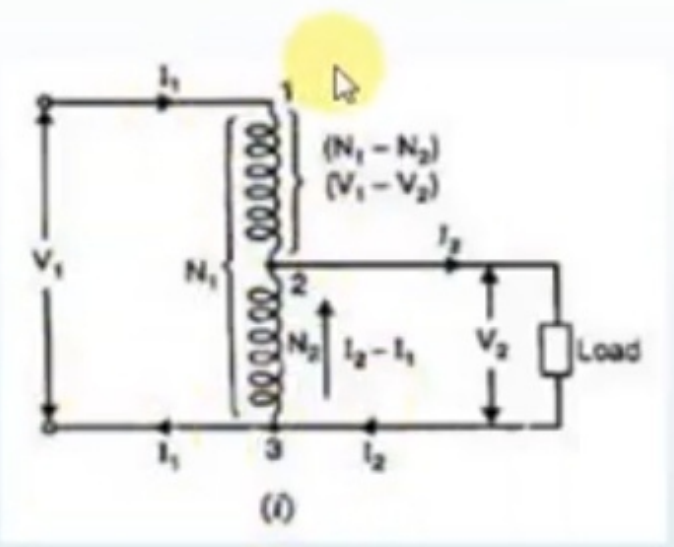

Auto-transformer
1

An **Auto Transformer** is a **transformer** with only one winding wound on a laminated core. An **auto transformer** is similar to a two winding **transformer** but differ in the way the primary and secondary winding are interrelated.



Theory of Autotransformer

- N1=primary turn(1-3)
- N2=secondary turn(2-3)
- I1=primary current
- I2=secondary current
- V1=primary voltage
- V2=secondary voltage



From Figure 1 we get:

$$\frac{V_2}{V_1 - V_2} = \frac{N_2}{N_1 - N_2}$$

$$V_2(N_1 - N_2) = N_2(V_1 - V_2)$$

$$V_2N_1 - V_2N_2 = N_2V_1 - N_2V_2$$

$$V_2N_1 = N_2V_1$$

$$\frac{V_2}{V_1} = \frac{N_2}{N_1} = K$$

3

Cont.....

$$\frac{V_2}{V_1} = \frac{I_1}{I_2}$$

$$V_1 I_1 = V_2 I_2 \qquad \text{(I/P=O/P)}$$

OUTPUT

The primary and secondary windings of an autotransformer are
Connected magnetically as well as electrically.
So the power transferred primary to secondary inductively as well as conductively.

Output apparent power = $V_2 I_2$

Apparent power transferred inductively = $V_2(I_2 - I_1) = V_2(I_2 - K I_2)$

$= V_2 I_2(1 - K) = V_1 I_1(1 - K)$

Power transferred inductively = Input $\times (1 - K)$

Power transferred conductively = Input – Input $(1 - K)$

$=$ Input $[1 - (1 - K)]$

$= K \times$ Input

4

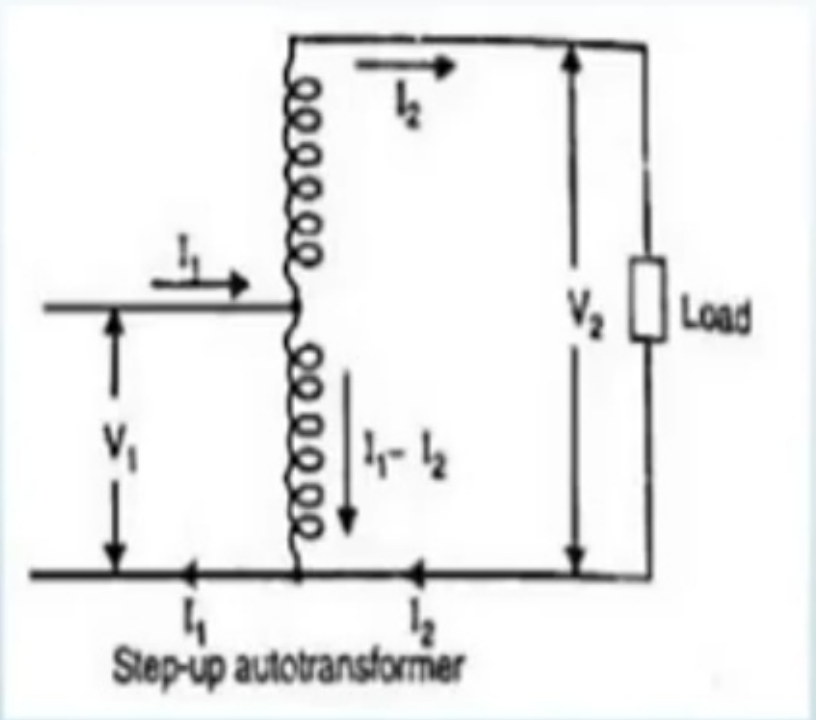
Types Of Autotransformers

- Step Up Auto-Transformer
- Step Down Auto-Transformer

5

Step Up Auto-Transformer

- An autotransformer in which Ns>Np is called a step up autotransformer. A step up autotransformer is a transformer which converts low alternatic voltage to high alternatic voltage.

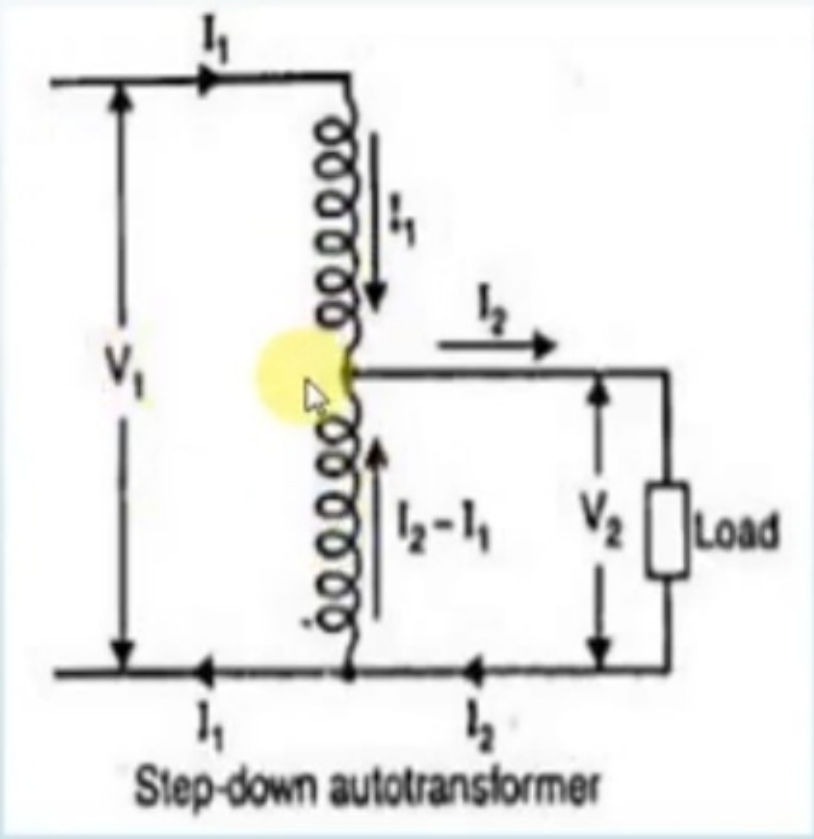


Step-up autotransformer

6

Step Down Auto-Transformer

- An autotransformer in which Np>Ns is called a step down autotransformer. A step down autotransformer is a transformer which converts high alternating voltage to low alternating voltage.



Step-down autotransformer

Advantages

- ✓ *Uses less copper two winding transformer*
- ✓ *Cheap cost*
- ✓ *Less copper losses*
- ✓ *Efficiency high*
- ✓ *Sparing (less) size*

8

Disadvantages

- ✓ *Does not offer electrical isolation, between 2 circuit.*
- ✓ *If common winding develops in open circuit.*

Use of autotransformer

- Domestic
- Commercial
- Industrial

10

Autotransformer

An autotransformer is a type of electrical transformer in which a part of the winding is common to both primary and secondary circuit. Unlike a two winding transformer where power transfer is only inductive, the power transformer in an autotransformer is both inductive and conductive.

Figure.1 shows a single phase autotransformer with N_p turns primary and N_s turns tapped from the primary in order to get a lower voltage. The winding section with N_s turns is common to both HV and LV side of the autotransformer. If

$$\frac{V_2}{V_1} = \frac{N_2}{N_1} = a$$

then,

$$\frac{\text{Conducted Power}}{\text{Input Power}} = 1 - a \tag{1}$$

$$\frac{\text{Transformed Power}}{\text{Input Power}} = a \tag{2}$$

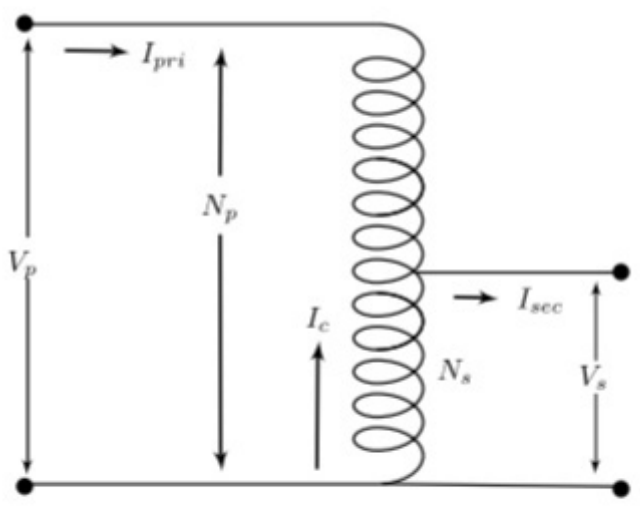


Figure 1: Autotransformer

Advantages

- For the same VA rating an autotransformer requires less copper, less iron and hence low exciting current, low ohmic loss and less weight as compared to a two winding transformer
- For the same material used, an autotransformer as compared to a 2-winding transformer gives higher output, has higher efficiency, lower leakage impedance and hence better voltage regulation.

Disadvantages

- They are used for a voltage ratio less than 2. If the ratio differs far from unity then the economic advantages decrease.
- A failure of the isolation of the windings of an autotransformer can result in full input voltage applied to the output. Also, a break in the part of the winding that is used as both primary and secondary will result in the transformer acting as an inductor in series with the load (which under light load conditions may result in near full input voltage being applied to the output)
- The short circuit current in Autotransformer is more than that in two winding transformer

11

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Figure 2: A 2.3 kVA, 10A single phase variac