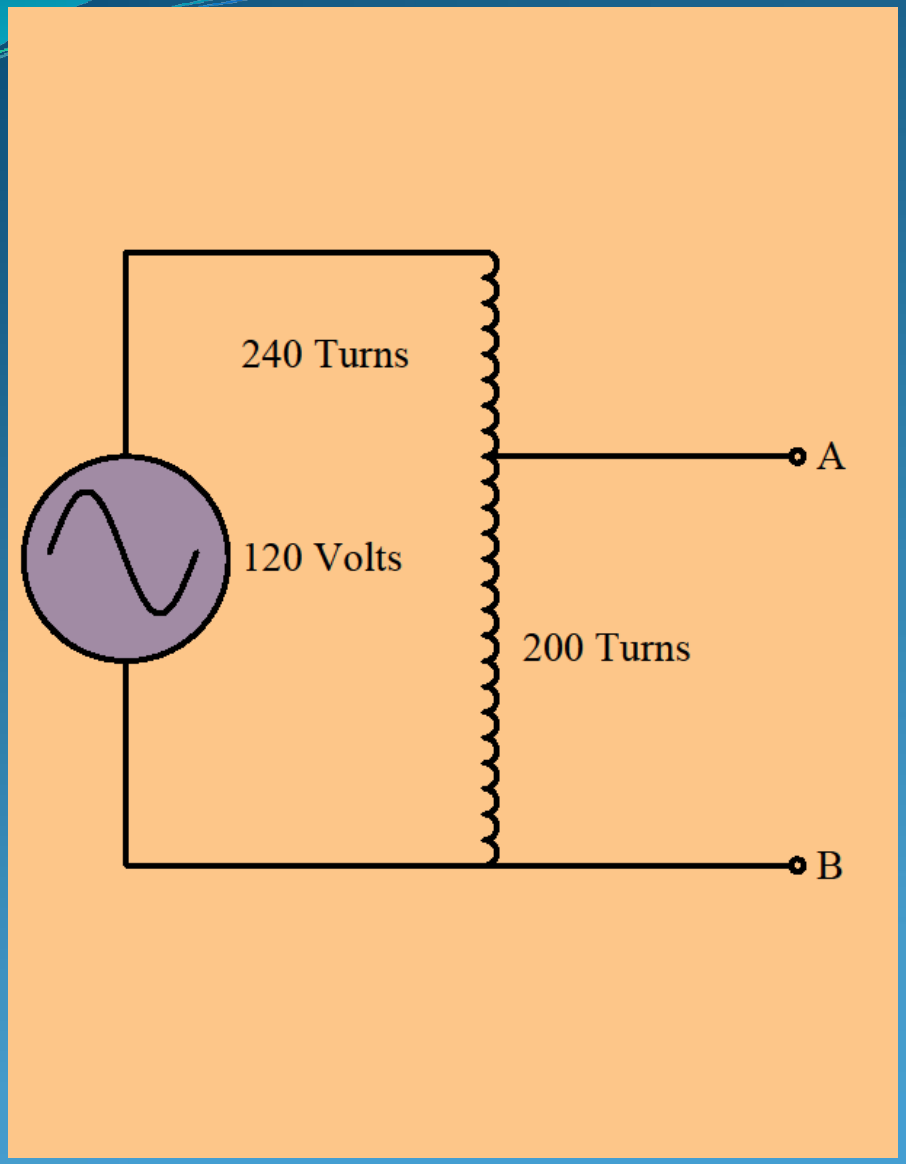
SECTION-B

AUTO TRANSFORMER

Autotransformers

- Autotransformers are transformers that contain only one winding.
  - The word “AUTO” means self.
  - An autobiography, for instance, is a book that someone writes about his or herself.



- The single winding of the autotransformer is both the primary and secondary.
- The primary winding is the part of the winding connected to the power source.
- The secondary winding is the part of the winding connected to the output or load.
  - In this example, the primary winding is connected across 240 turns of wire and the output is between terminals A and B.
  - The output contains 200 turns of wire.

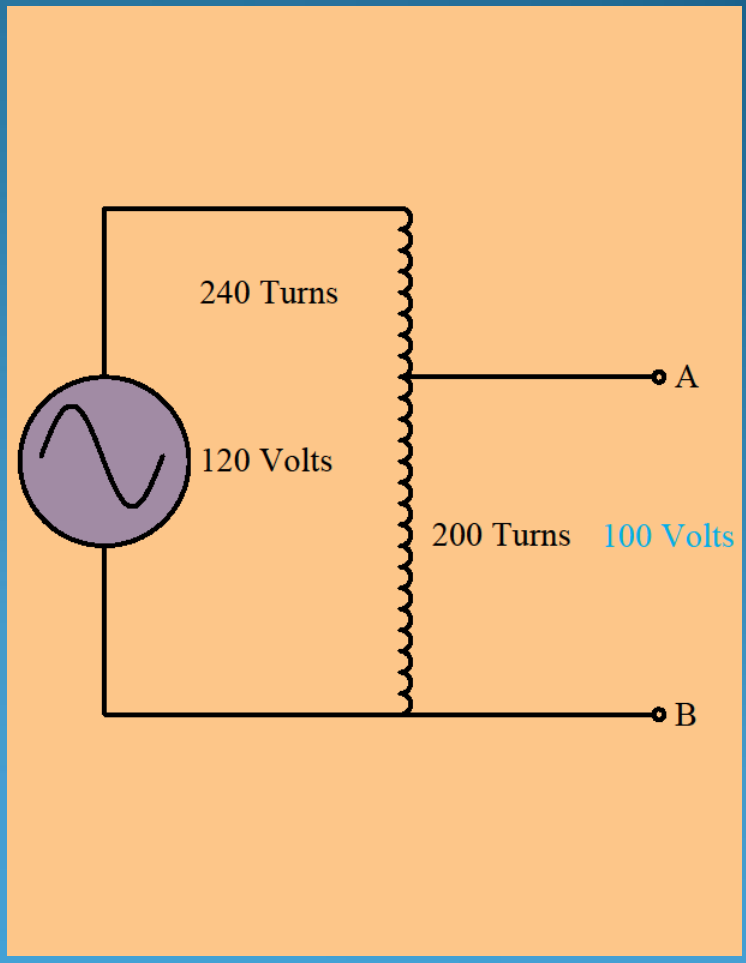
- Different methods can be employed to determine the amount of output voltage.
  - One method is with the use of transformer formulas.

$$\frac{N_P}{N_S} = \frac{E_P}{E_S} \qquad \frac{240}{200} = \frac{120}{E_S}$$

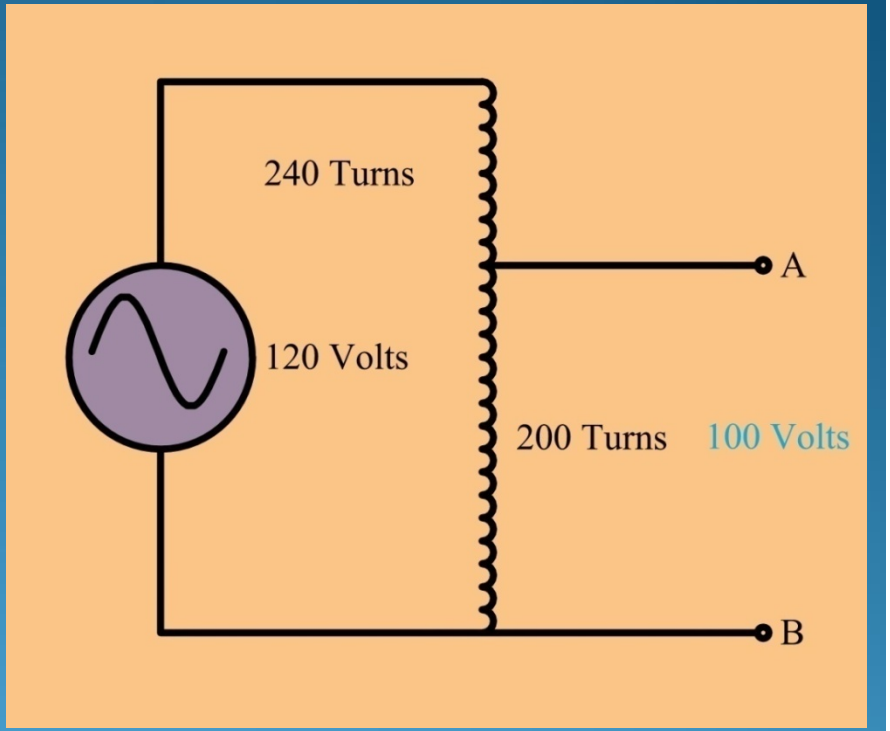
$$240\,E_S = 24{,}000$$

$$\frac{\cancel{240}\,E_S}{\cancel{240}} = \frac{24{,}000}{240}$$

$$E_S = 100\ \text{V}$$

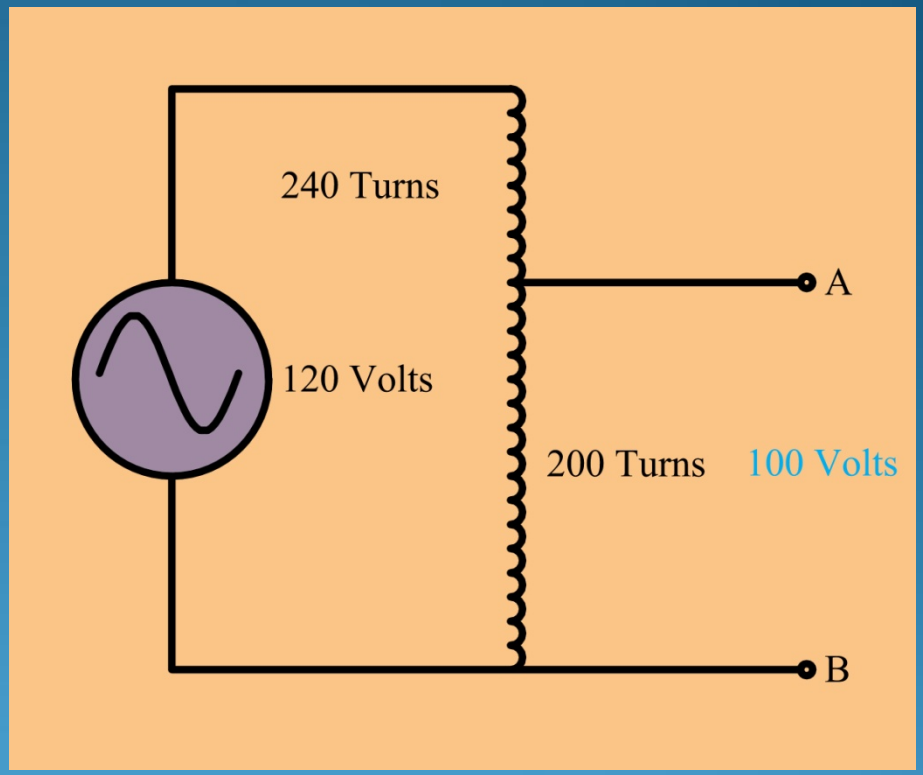


- Another method of determining voltage when the number of turns are known is by the **volts per turn.**
- The primary windings **always** determine the volts per turn of the transformer.
  - In this example, the primary contains 240 turns of wire and has an applied voltage of 120 volts.
  - To determine the volts per turn of the transformer, divide the volts by the number of turns. (120/240 = 0.5 volts per turn)

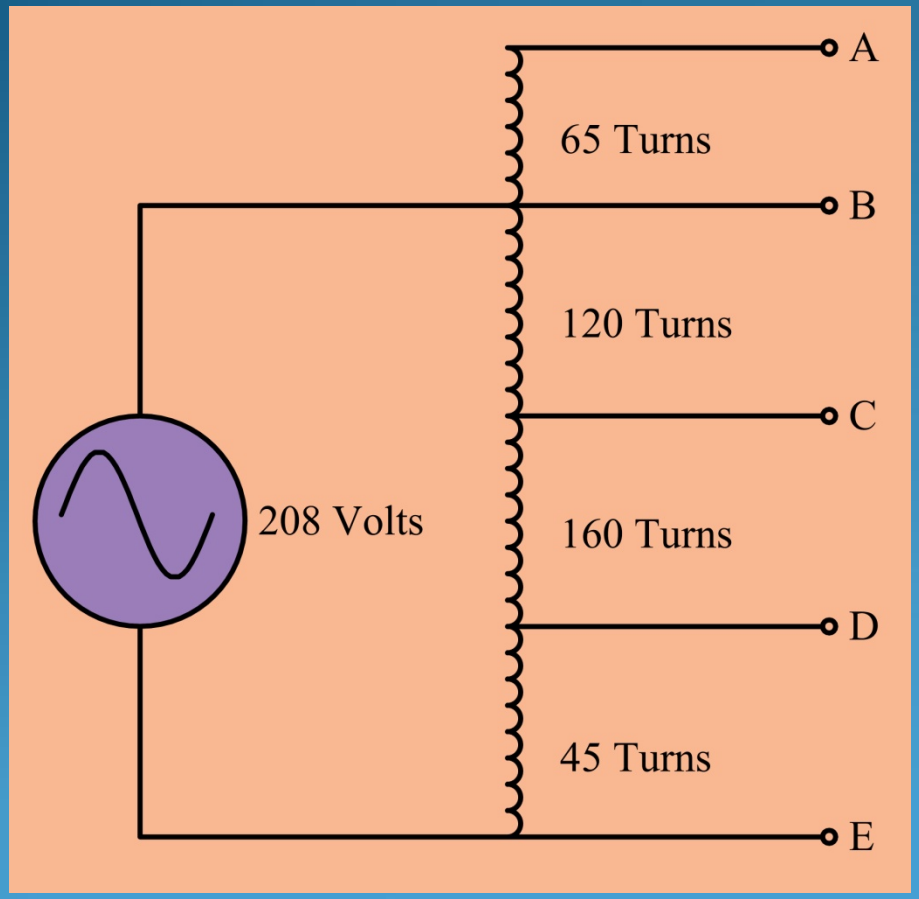


- In this example, the secondary portion of the winding contains 200 turns of wire.
- Since the volts per turn for this transformer is 0.5, the secondary voltage can be determined by multiplying the number of secondary turns by the volts per turn.

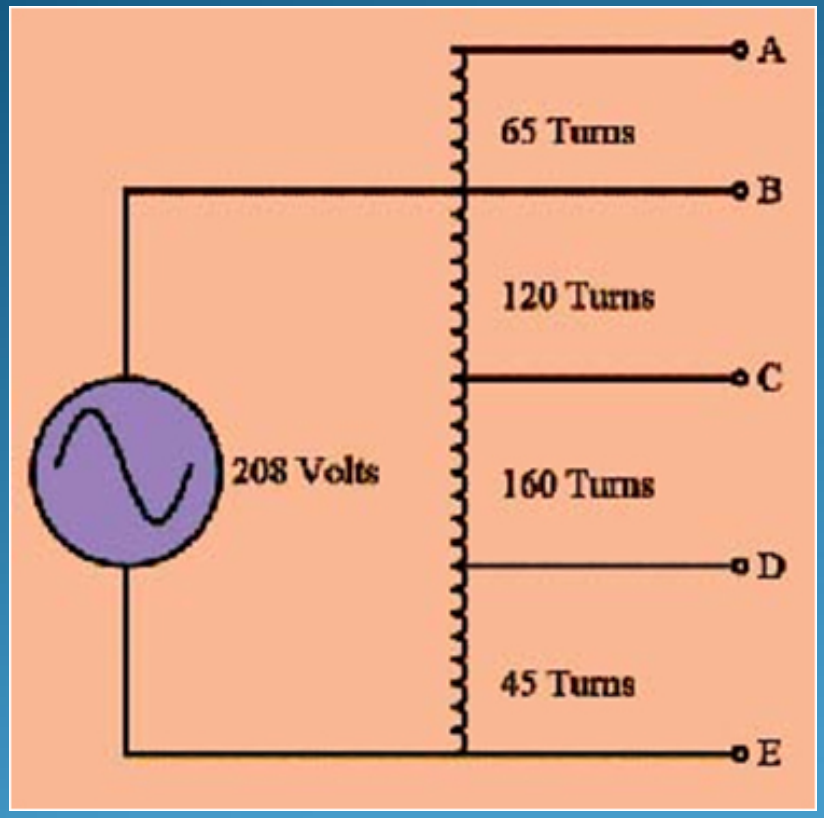
(200 x 0.5 = 100 volts)



Multiple Taps

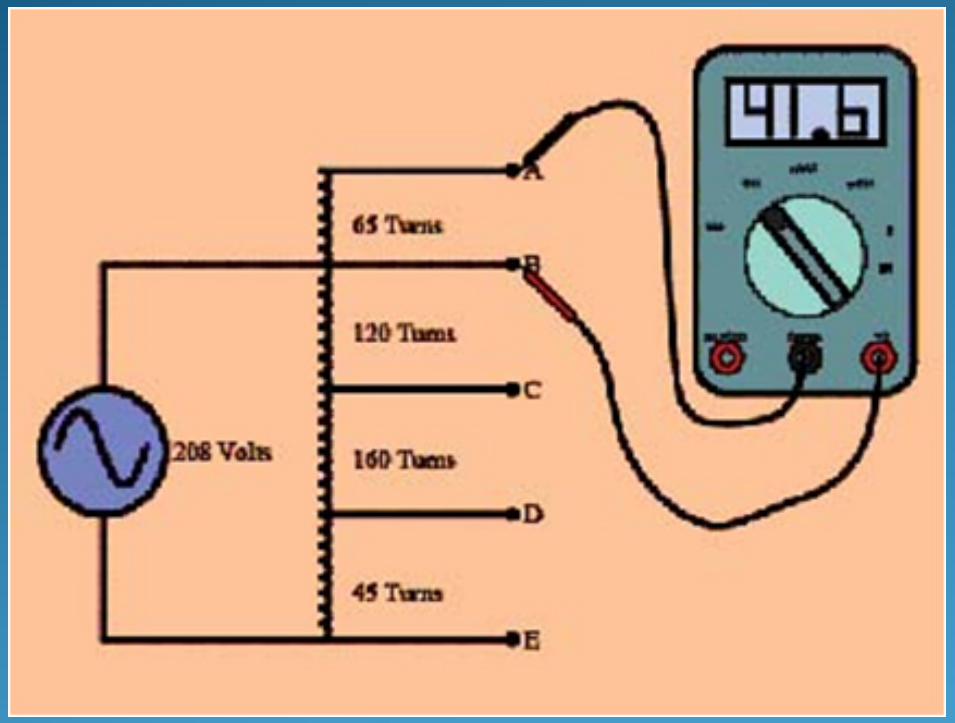


- Autotransformers can contain multiple taps.
- In this example, there are **65** turns of wire between terminals A and B, **120** turns between terminals B and C, **160** turns between taps C and D, and **45** turns between taps D and E.



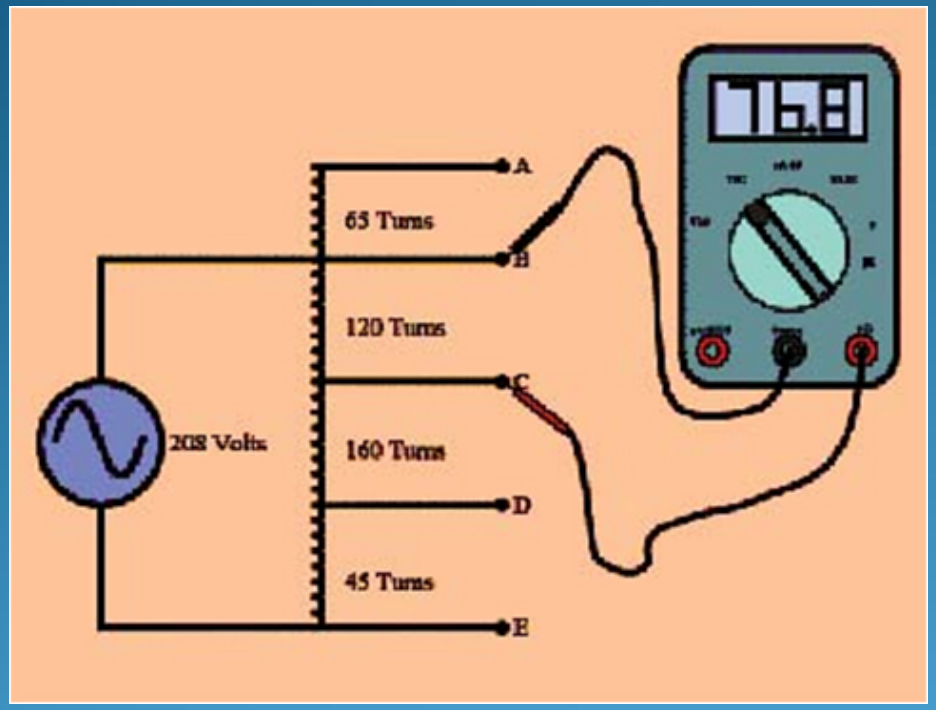
- The first step in determining the voltage produced between each tap is to determine the volts per turn of the transformer.
- The primary or input is located between taps B and E.
- This winding contains a total of 325 turns. (120 + 160 + 45)

  (208 volts / 325 turns = 0.64 volts per turn)



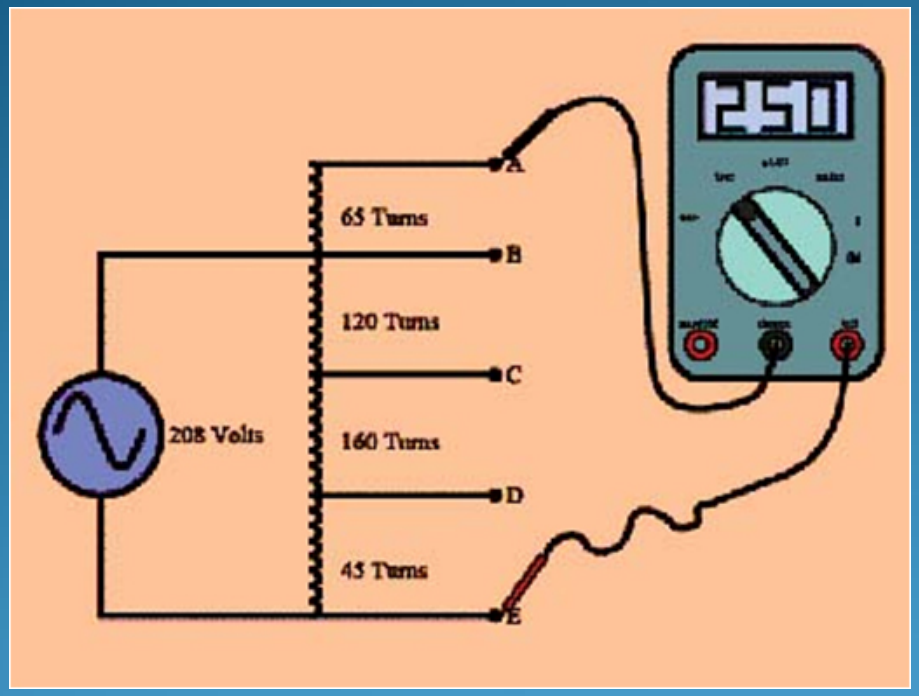
- The amount of voltage across terminals A and B can be determined by multiplying the number of turns by the volts per turn of the transformer.

  (65 turns x 0.64 volts per turn = 41.6 volts)
- A voltmeter connected across terminals A and B would indicate a voltage of 41.6 volts.



- The voltage between any terminals can be determined in the same way.
- Between terminals B and C there are 120 turns of wire.
- The voltage between these two terminals is 76.8 volts.

(120 turns x 0.64 volts per turn = 76.8 volts)



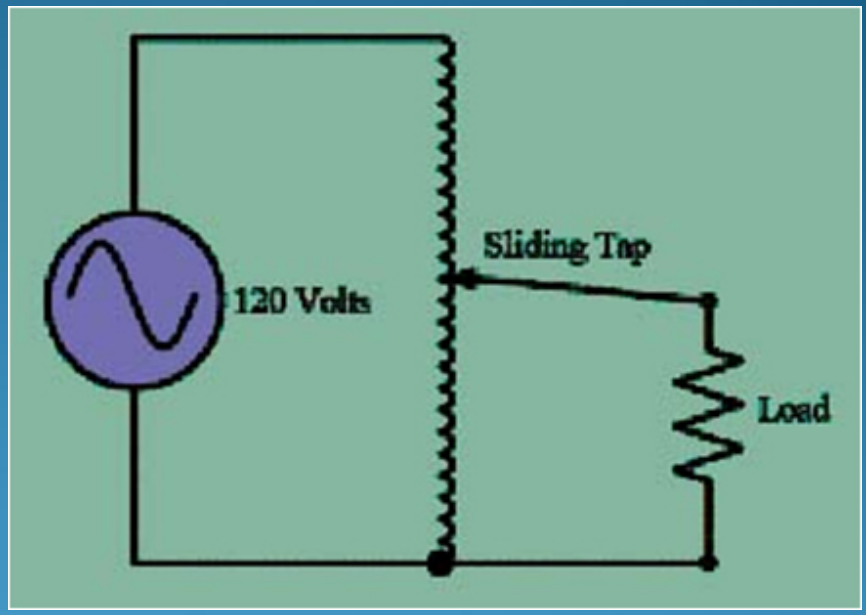
- Between terminals A and E there are 390 turns of wire.

  (65 + 120 + 160 + 45 = 390)

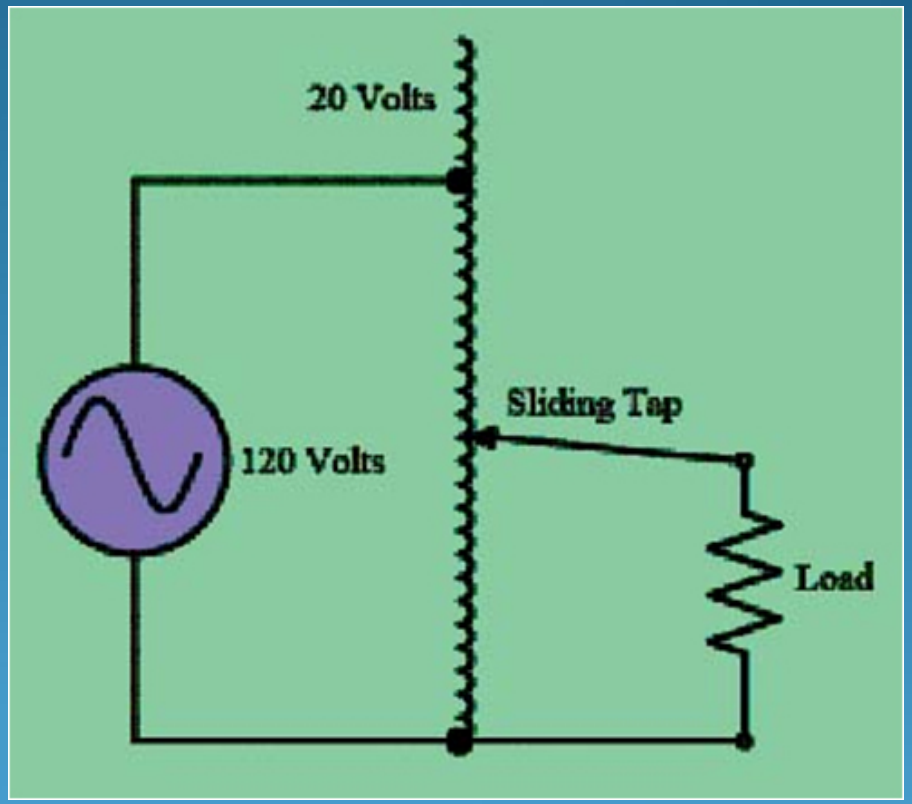
- The voltage between terminals A and E is 249.6 volts.

  (390 x 0.64 = 249.6 volts)

- Some autotransformers contain a sliding tap that permits the turns ratio to be changed over the full range of the transformer.
- These transformers are often called variable transformers.
  - In the example, the voltage to the load can be adjusted for any value between 0 and 120 volts.
  - Common brand names for these transformers are Powerstat and Variac.

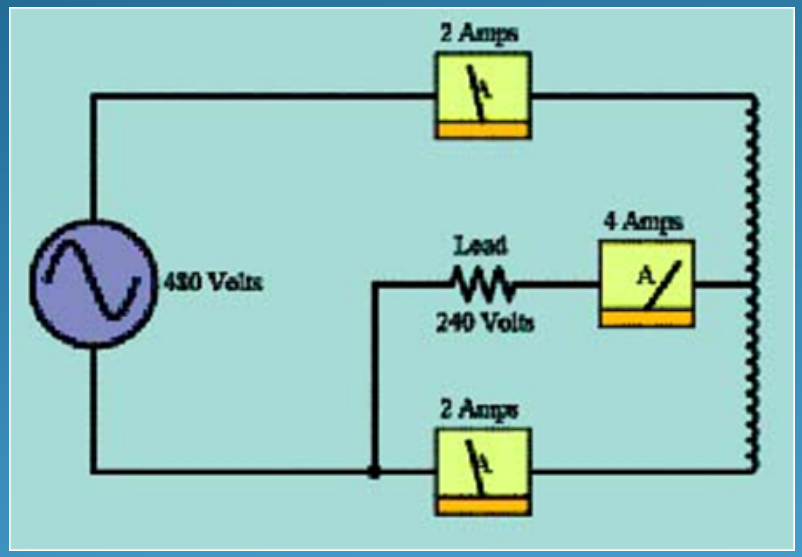


- Variable transformers are often designed to permit a step-up in voltage.
- In the example, the transformer can provide an output voltage of 0 to 140 volts instead of 0 to 120 volts.



- The transformer shown is a variable transformer.
- To connect the transformer to operate between 0 and 120 volts, connect power to terminals 2 and 4.
- The load is connected between terminals 3 and 4 or 3 and 2.
- If the transformer is to provide voltages between 0 and 140 volts, connect power to terminals 2 and 5 or 1 and 4.
- If power is connected to terminals 2 and 5, the load will be connected to terminals 3 and 4. If power is connected to terminals 1 and 4, the load will be connected to terminals 3 and 2.

Current in an Autotransformer



- An autotransformer is employed to reduce 480 volts to 240 volts to operate a load.
- The load has a current draw of 4 amperes.
- Each of the primary lines supplying power to the transformer winding will have a current flow of 2 amperes.
- One of the common rules that apply to transformers is the power in must equal the power out.

(480 volts x 2 amps = 960 VA)
(240 volts x 4 amps = 960 VA)

Advantages and Disadvantages

- Autotransformers offer some advantages over isolation-type transformers and also have some disadvantages.

Advantages

- Autotransformers are generally less expensive than isolation-type transformers because they contain only one winding.
- Autotransformers generally exhibit very high efficiencies in the range of 98% to 99%.
- Autotransformers can provide variable voltages.

Disadvantages

- The main disadvantage of an autotransformer is that it does not provide line isolation from the power source.
- Isolation-type transformers are often used because of their ability to reduce voltage spikes and electrical noise that occur in the power source. Since there is no separation between the load and the power source, autotransformers will transmit spikes and electrical noise to the load.