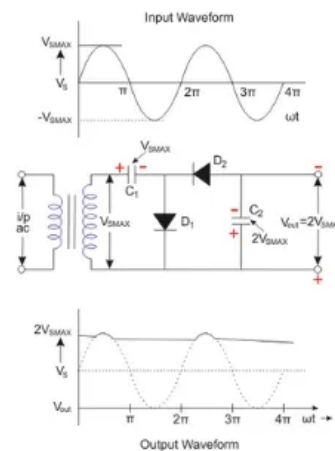
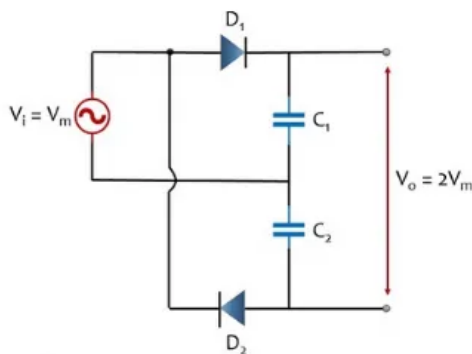


## Voltage Doubler: What is it? (Circuit Diagram, Input Wave & Output Wave)

Last updated April 5, 2021 by Electrical4U

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# What is Voltage Doubler?



**E4U Electrical 4 U**

## What is a Voltage Doubler?

A voltage doubler is an electronic circuit that produces an output voltage that is double the input voltage. It is a voltage multiplier with a voltage multiplication factor equal to 2. The circuit is formed by an oscillating AC input voltage, two capacitors, and two diodes. The input voltage is AC, and the output is DC voltage with twice the peak value of the input AC voltage.

In some applications, heavy and expensive step-up transformers can be replaced by voltage doublers.

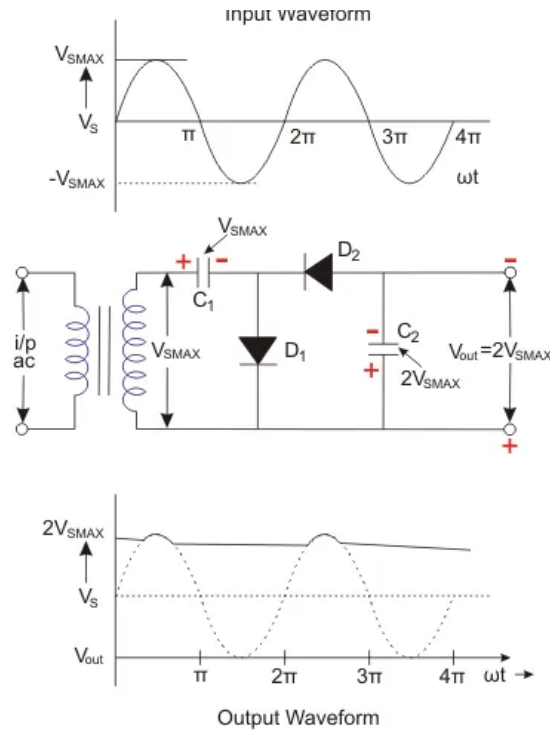
There are two main types of voltage doublers: half wave voltage doublers and full wave voltage doublers.

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## Types of Voltage Doubler

### Half Wave Voltage Doubler

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Now, we can go through the working of the half-wave DC voltage doubler. All over the positive half cycle of the AC sine wave, the first diode ( $D_1$ ) is conducting.

That is a forward biased state, and it will charge the connected capacitor ( $C_1$ ) equal to the peak value of AC secondary voltage of transformer ( $V_{S\text{MAX}}$ ).

This capacitor is unable to get discharged due to the unavailability of a path. So, it will remain in a fully charged condition.

Next, all over the negative half cycle, the second diode ( $D_2$ ) is conducting or forward biased state, and the first diode ( $D_1$ ) is non-conducting or in the reversed biased state.

The reversed biased diode ( $D_1$ ) will block the discharging of the connected capacitor ( $C_1$ ), and the forward-biased diode

Here we can apply Kirchhoff's voltage law to the outer loop, which starts from the bottom of the secondary of the transformer (the lower end is negative and the top end is in positive polarity) in the clockwise direction.

$$-V_{S2} + V_{C2} + V_{S1} + V_{C1} - V_{S1} = 0$$

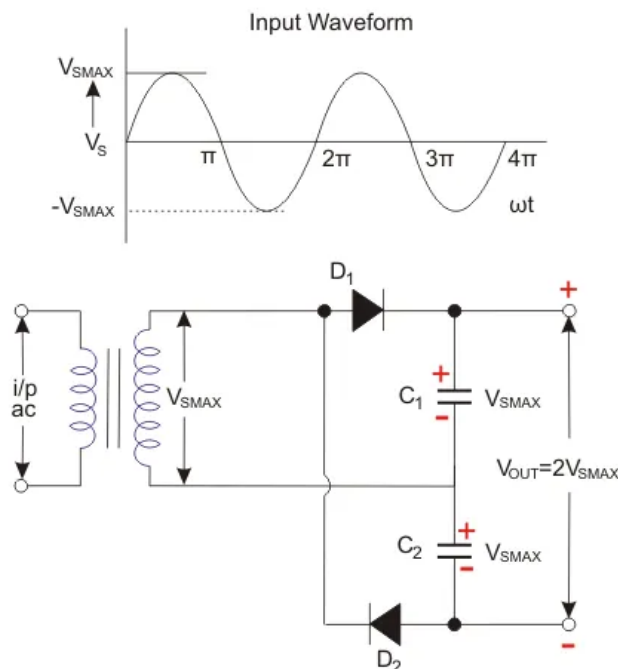
That is the voltage across the capacitor;  $C_2$  will be equal to two times the peak value of input transformer secondary voltage ( $2V_{S\text{MAX}}$ ).

Throughout the next positive half cycle of AC input, the second diode ( $D_2$ ) will be open due to the reversed biased condition. So, the second capacitor ( $C_2$ ) will get discharged through the load and the output voltage ( $V_{\text{out}} < 2V_{S\text{MAX}}$ ).

Otherwise, the two capacitors will be in the charged condition as said above. If there is a load, then in the next cycle, the  $C_2$  will get recharged again.

## Full Wave Voltage Doubler

In the **full-wave voltage doubler**, the components are the same as that of half-wave voltage doubler. But difference is in the circuit, as shown below.



In this doubler, right through the positive cycle of input AC voltage, the first diode ( $D_1$ ) is in the conducting state.

That is a forward biased state, and it will charge the connected capacitor ( $C_1$ ) equal to the peak value of AC secondary voltage of transformer ( $V_{S\text{MAX}}$ ).

At this time,  $D_2$  will be in reverse biased condition or non-conducting state. Throughout the negative cycle of input AC voltage, the second diode ( $D_2$ ) will be in forwarding biased state, and the second capacitor ( $C_2$ ) gets charged. X

In the no-load condition, the entire voltages of two capacitors

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If there is some load connected across the output terminals, then output voltage ( $V_{out}$ )  $< 2V_{S\ MAX}$ . The output waveform is shown below.

We can observe that both the **voltage doubler** will provide  $2V_{S\ MAX}$  as the output. There is no need for a centre-tapped transformer.  $2V_{S\ MAX}$  will be the peak inverse voltage ratings of the circuit diodes.

## Advantages of Voltage Doubler

The advantages of voltage doublers include:

- Can replace the expensive and heavy transformers.
- Negative voltage can also be created by reversing the polarity of the connected diodes and capacitors.
- Can increase the voltage multiplication factor by cascading the similar voltage multipliers.

## Application of Voltage Doubler

The applications of voltage doublers include:

- Ion pumps
  - Television CRT
  - X-Ray systems
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