



Electronic Circuits-1(CNET-112)

Level 4th

Department of CNET

College of CS & IS

Jazan University

KSA

CHAPTER -4

APPLICATIONS OF DIODE

Objectives

In this Chapter, student will learn the following topics:-

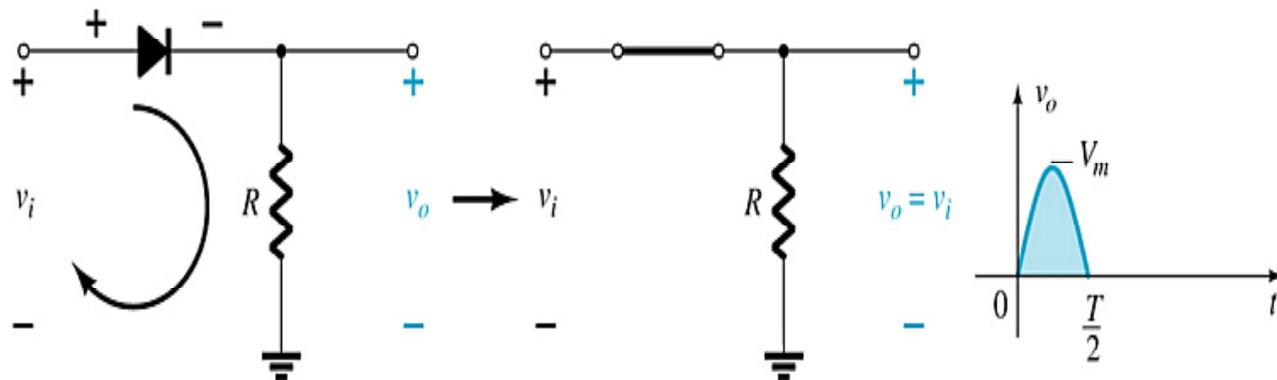
- Half Wave Rectifier
- Peak Inverse Voltage
- Center-Tapped Transformer Rectifier
- Bridge Rectifier
- Clippers (Biased & Parallel) and Clampers
- Voltage-Multiplier Circuits (Voltage Tripler and Quadrupler)

Rectifier

It's a circuit which is used to convert AC into DC.

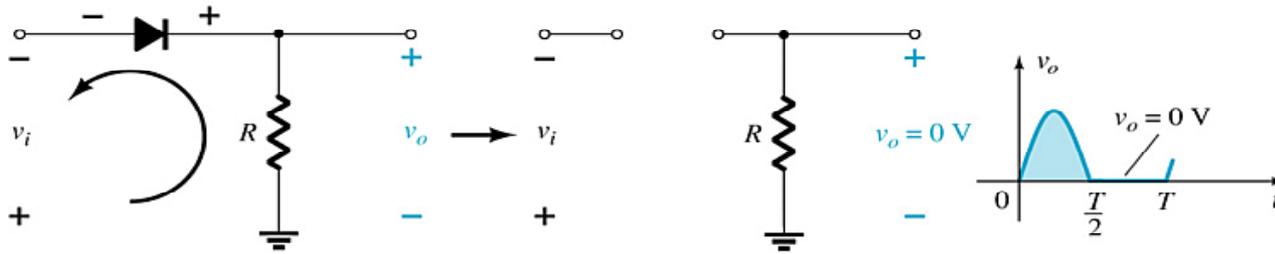
Half-Wave Rectifier

The diode only conducts when it is forward biased, therefore only half of the AC cycle passes through the diode to the output.



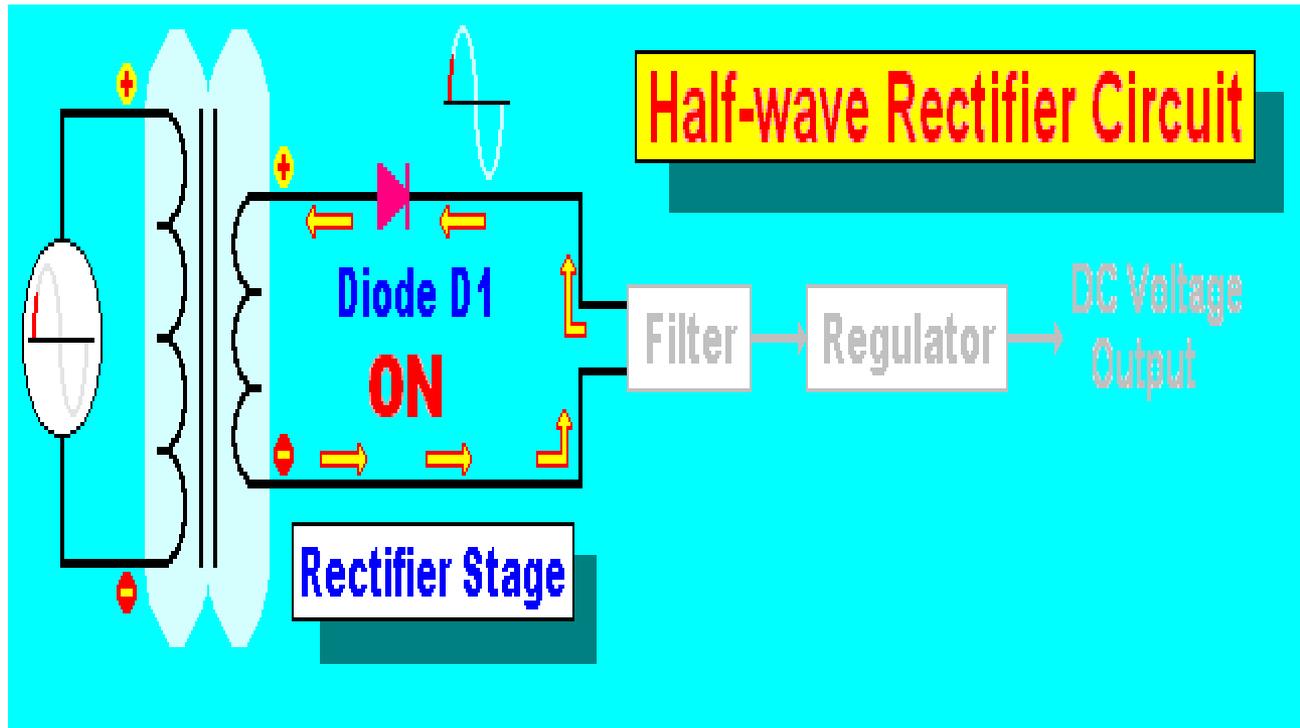
مقوم
DC إلى AC إنها دائرة تستخدم لتحويل

المعدل نصف الموجي
يحدث الصمام الثنائي فقط عندما يكون متحيزاً للأمام ، لذلك
لا يمر سوى نصف دورة التيار المتناوب عبر الصمام الثنائي
إلى المخرج.



The DC output voltage is $0.318 V_m$, where $V_m =$ the peak AC voltage.

Half-Wave Rectifier



Half-Wave Rectifier (*Video*)



- **PIV (PRV)**

- **Because the diode is only forward biased for one-half of the AC cycle, it is also reverse biased for one-half cycle.**
- **It is important that the reverse breakdown voltage rating of the diode be high enough to withstand the peak, reverse-biasing AC voltage.**

– $\text{PIV (or PRV)} > V_m$

PIV = Peak inverse voltage

PRV = Peak reverse voltage

V_m = Peak AC voltage

PIV (PRV)

ولأن الصمام الثنائي متحيز للأمام فقط لنصف دورة التيار المتناوب ، فإنه ينحاز أيضاً إلى عكس دورة الشوط الواحد .

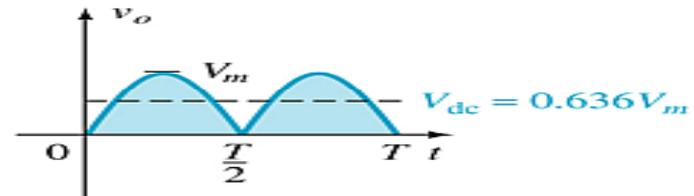
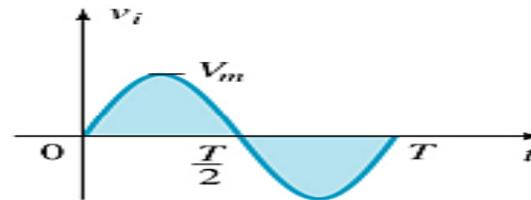
من المهم أن يكون تصنيف جهد الانهيار العكسي للصمام الثنائي عالياً بما يكفي لتحمل الذروة ، انحياز التيار المتردد العكسي .

• Full-Wave Rectification

- The rectification process can be improved by using a full-wave rectifier circuit.
- Full-wave rectification produces a greater DC output:

- **Half-wave:** $V_{dc} = 0.318 V_m$

- **Full-wave:** $V_{dc} = 0.636 V_m$



تصحيح كامل الموجة

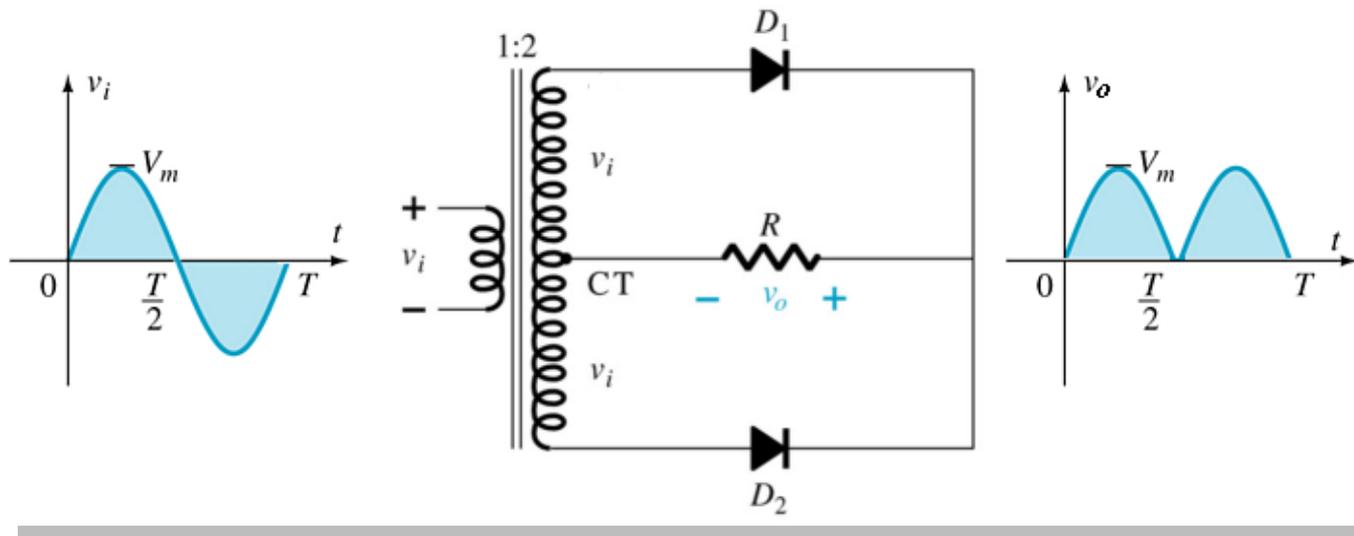
يمكن تحسين عملية التصحيح باستخدام دائرة مقوم الموجة الكاملة.

أكبر DC ينتج تصحيح الموجة الكاملة خرج

Full-Wave Rectification

1. Center-Tapped Transformer Rectifier

- **Requires**
 - **Two diodes**
 - **Center-tapped transformer**
 - $V_{DC} = 0.636 V_m$



المعدل المحول

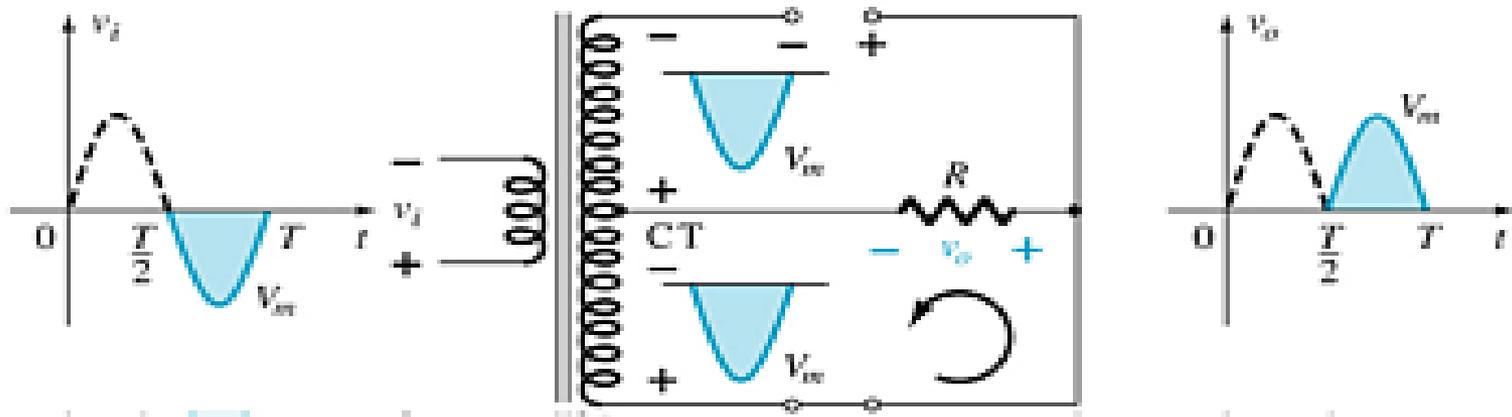
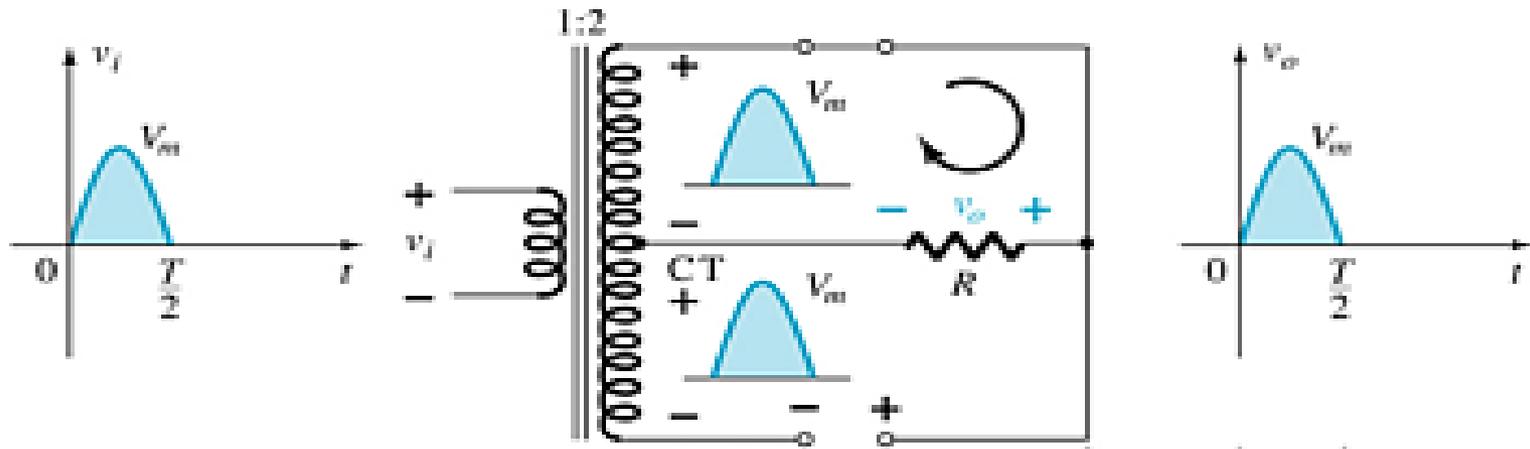
يتطلب

اثنين من الثنائيات

مركز محولات استغلالها

Full-Wave Rectification

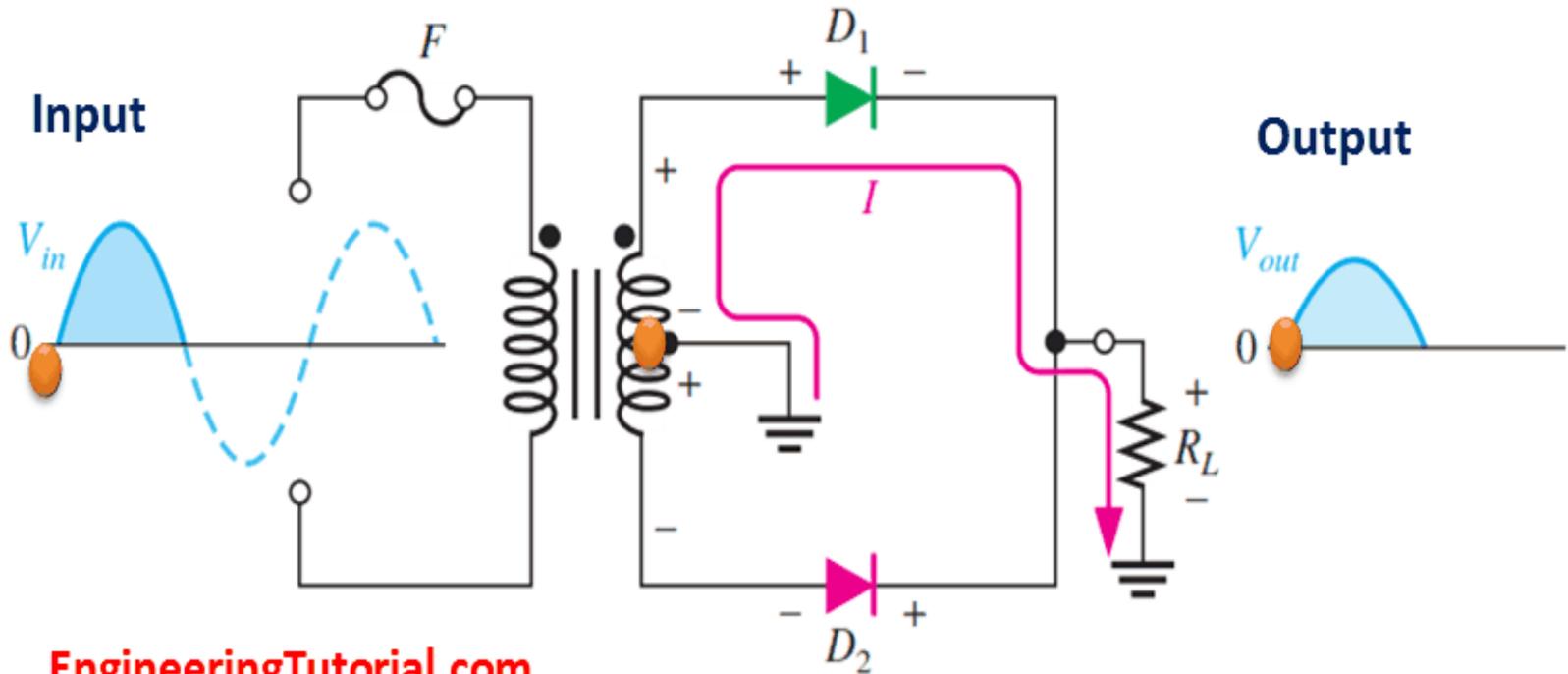
During Positive And Negative Cycle



Center Tapped Full Wave Rectifier

During Positive Half Cycle

D_1 : Forward Bias – Closed Circuit



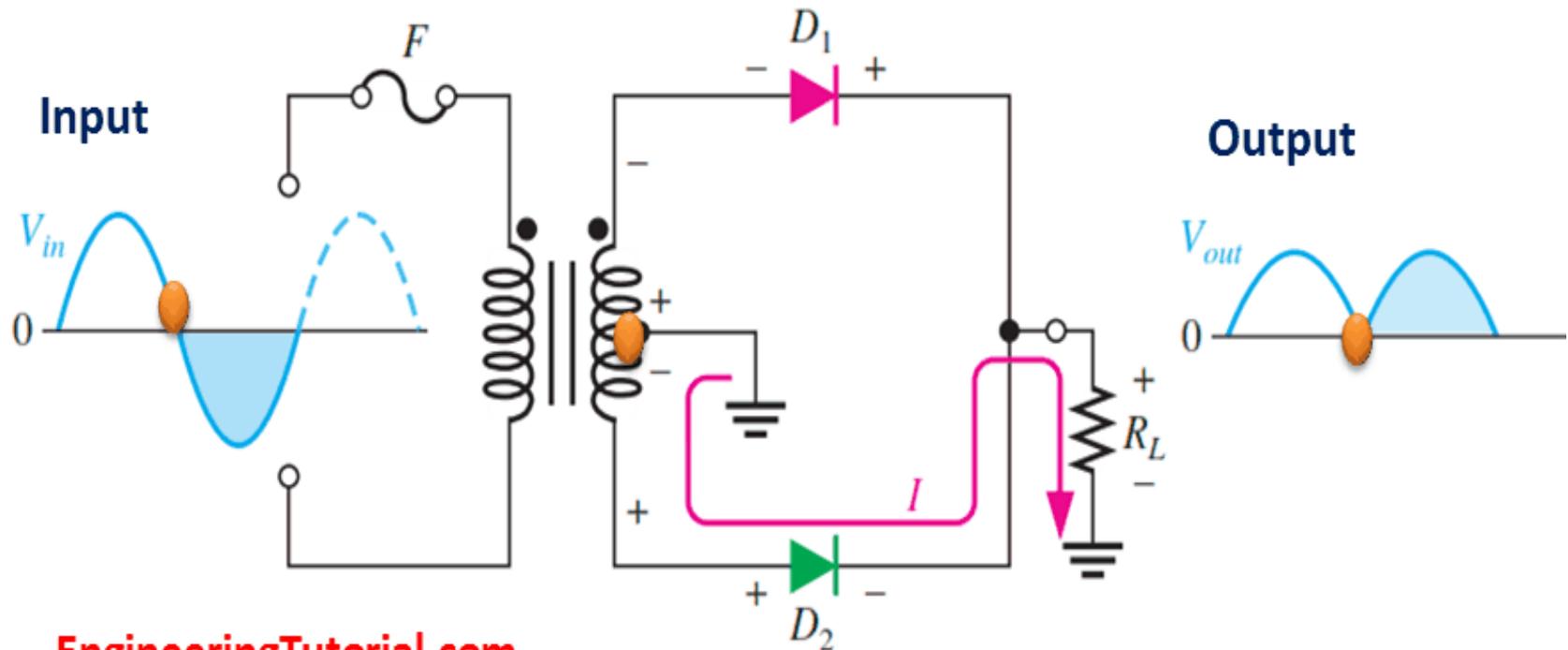
EngineeringTutorial.com

D_2 : Reverse Bias – Open Circuit

Center Tapped Full Wave Rectifier

During Negative Half Cycle

D_1 : Reverse Bias – Open Circuit



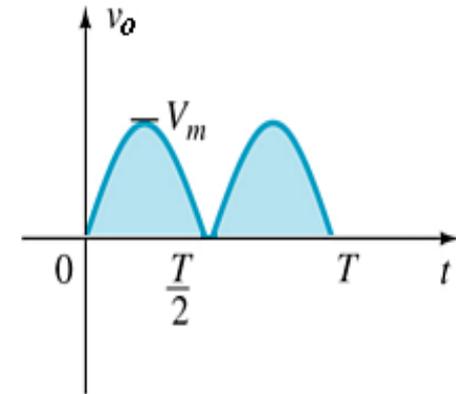
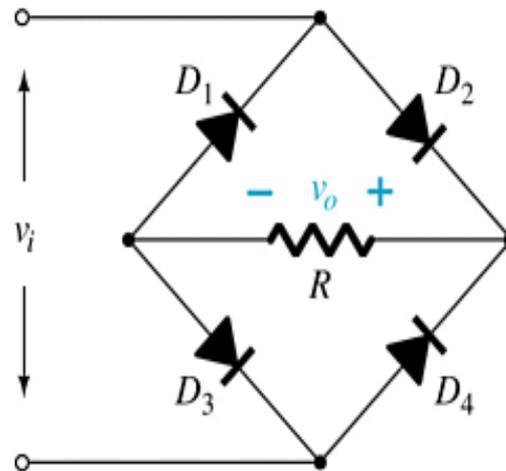
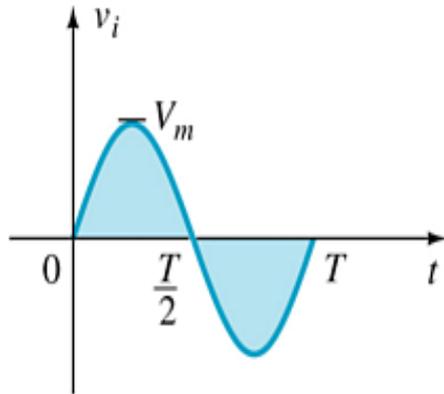
EngineeringTutorial.com

D_2 : Forward Bias – Closed Circuit

Full-Wave Rectification

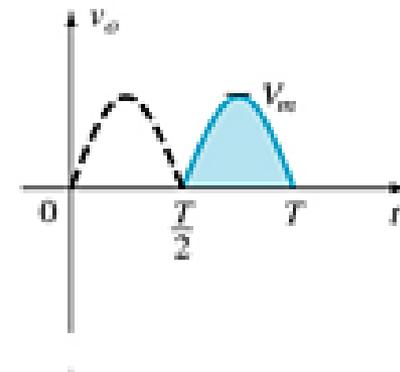
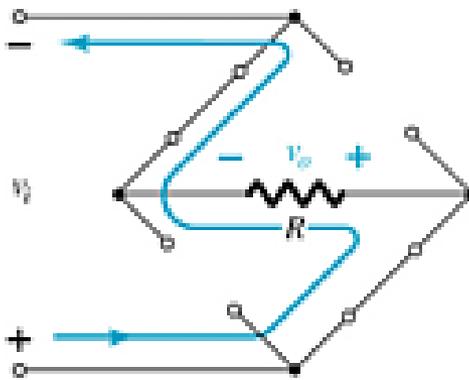
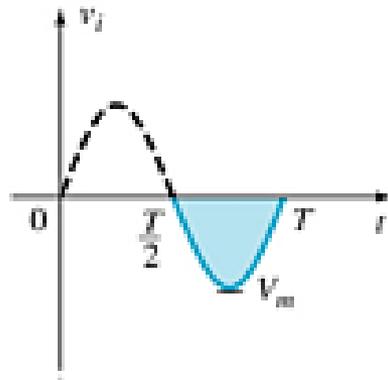
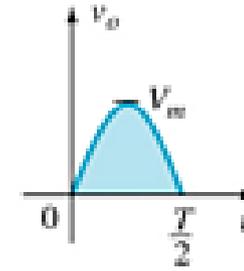
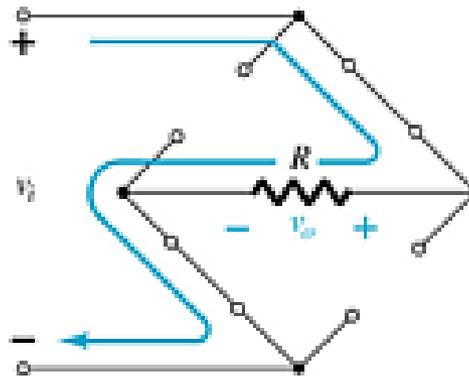
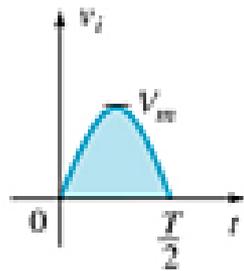
Bridge Rectifier

- Four diodes are connected in a bridge configuration
- $V_{DC} = 0.636 V_m$

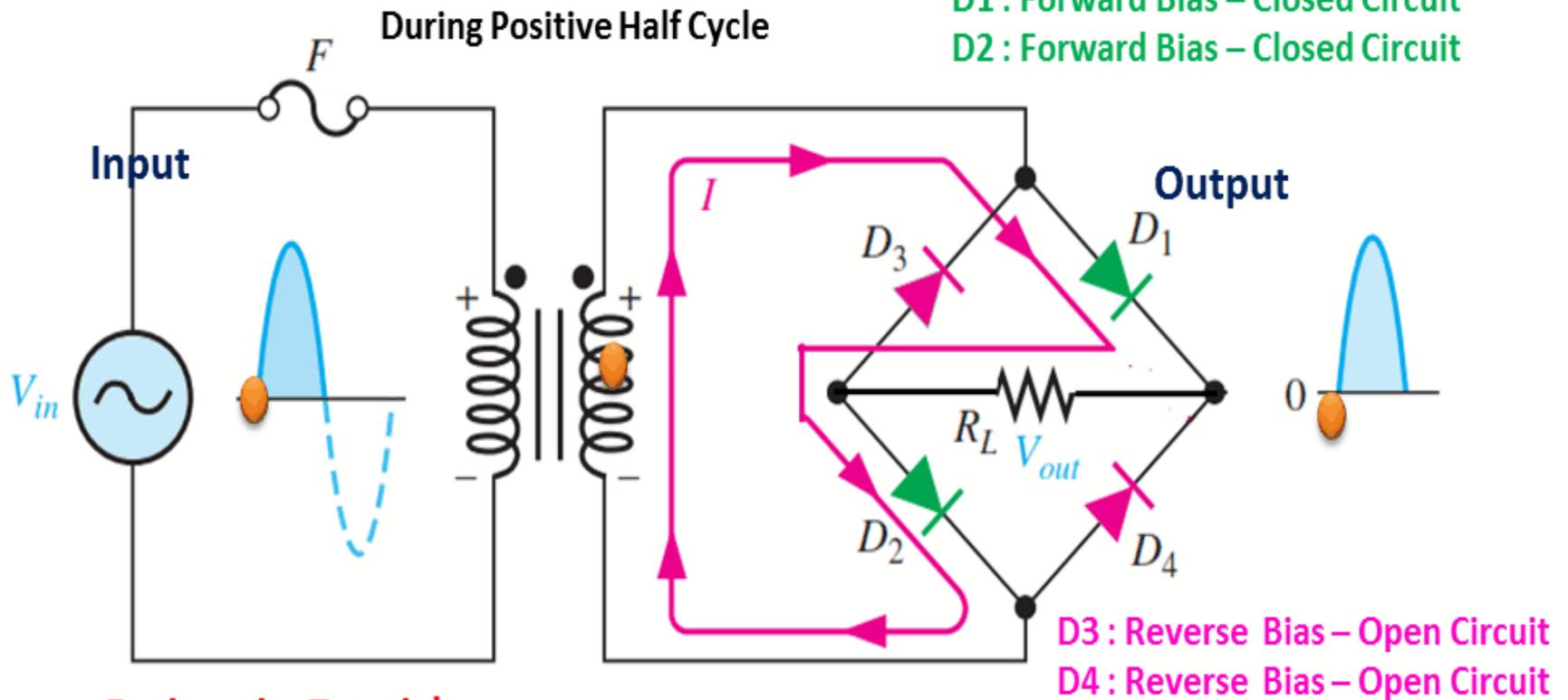


Full-Wave Rectification

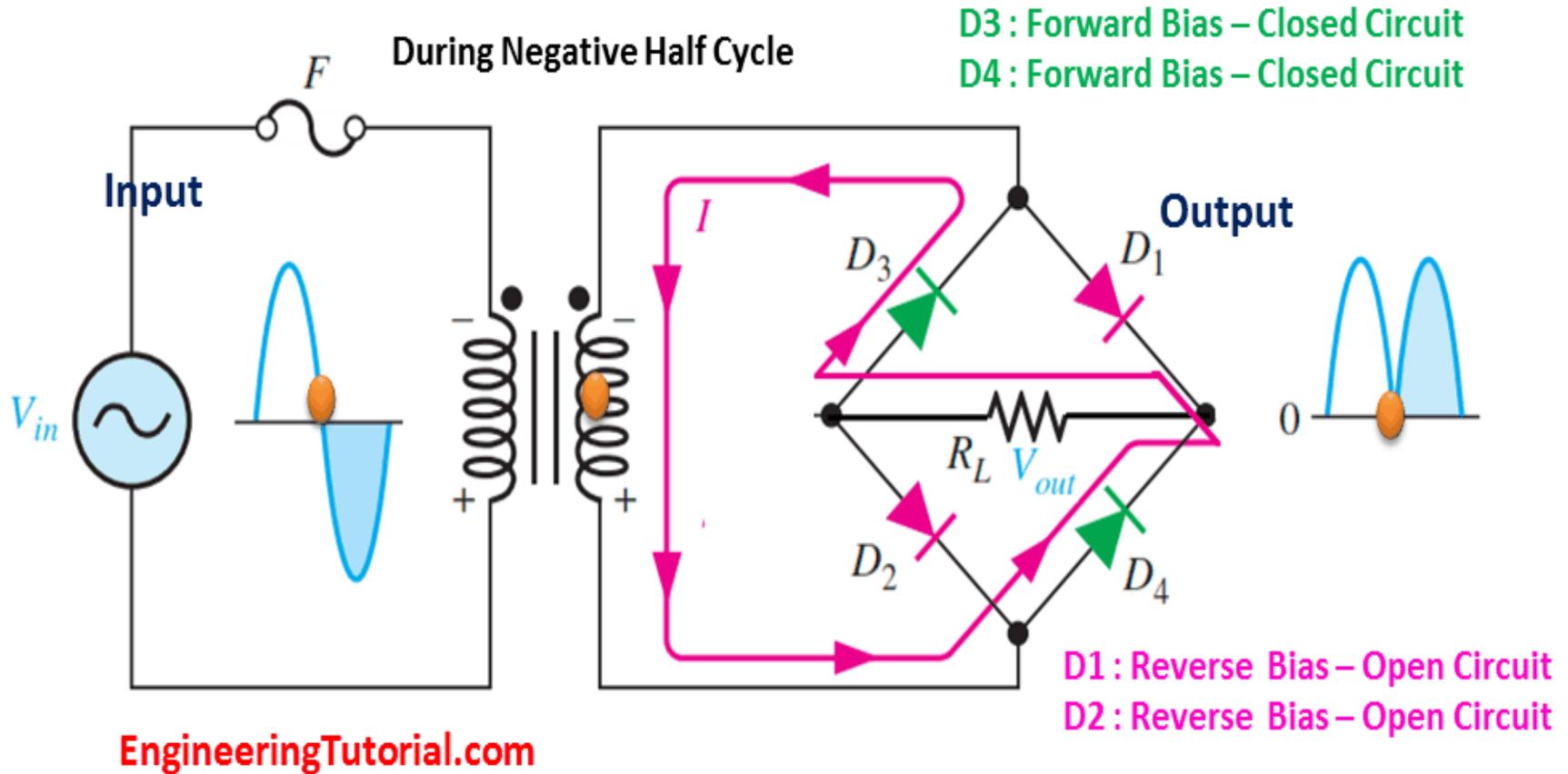
During Positive And Negative Cycle



Bridge Full Wave Rectifier



Bridge Full Wave Rectifier



Bridge Rectifier (*Video*)



Summary of Rectifier Circuits

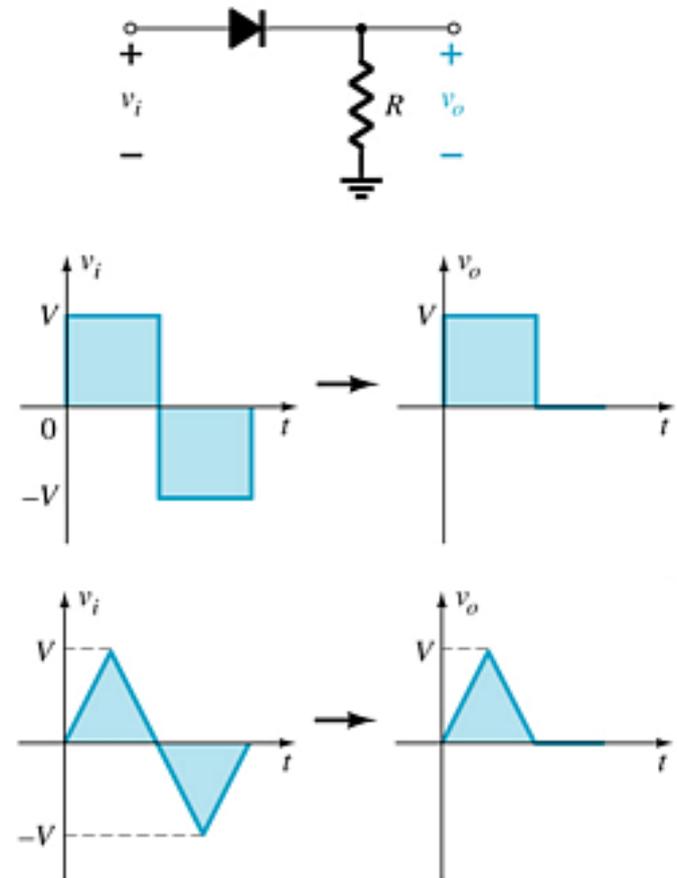
Rectifier	Ideal V_{DC}	Realistic V_{DC}
Half Wave Rectifier	$V_{DC} = 0.318 V_m$	$V_{DC} = 0.318 V_m - 0.7$
Bridge Rectifier	$V_{DC} = 0.636 V_m$	$V_{DC} = 0.636 V_m - 2(0.7 \text{ V})$
Center-Tapped Transformer Rectifier	$V_{DC} = 0.636 V_m$	$V_{DC} = 0.636 V_m - 0.7 \text{ V}$

- $V_m =$ peak of the AC voltage.
- In the center tapped transformer rectifier circuit, the peak AC voltage is the transformer secondary voltage to the tap.

AC. ذروة الجهد
في الدائرة المقوية لمحول المحول ، فإن جهد التيار المتردد
للذروة هو الجهد الثانوي للمحولات إلى الصنبور

Diode Clippers

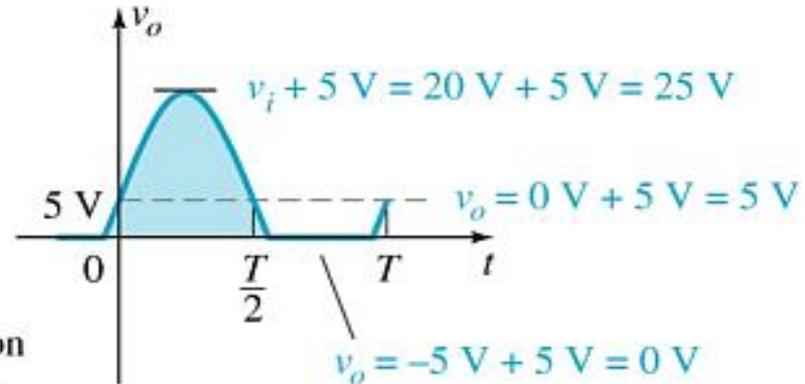
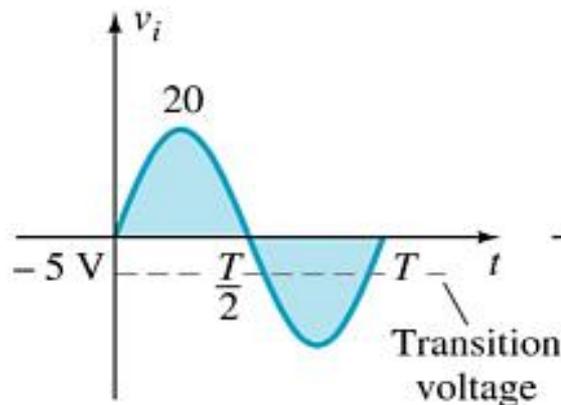
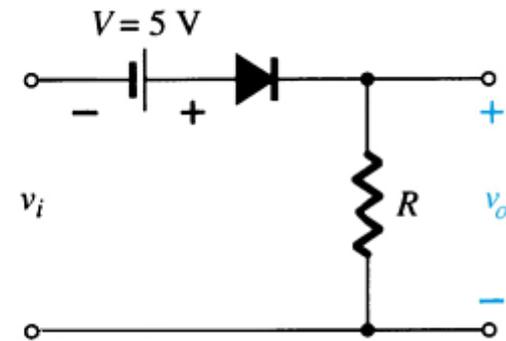
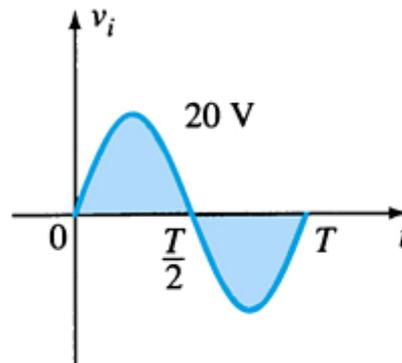
- The diode in a **series clipper** “clips” any voltage that does not forward bias it:
- A reverse-biasing polarity
- A forward-biasing polarity less than **0.7 V** (for a silicon diode)



الصمام الثنائي في سلسلة "كليببات" أي الجهد الذي لا يتحيز
إلى الأمام
انعكاس عكسي
الانعكاس إلى الأمام قطبية أقل
من ٠,٧ فولت (لسيليكون الصمام الثنائي)

Biased Clippers

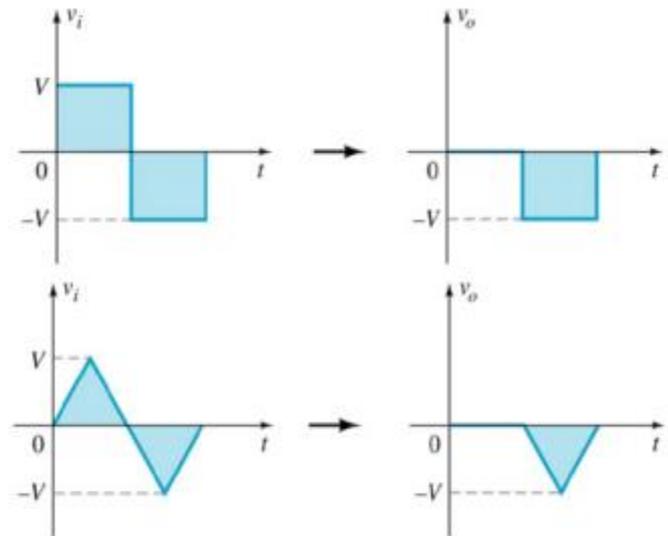
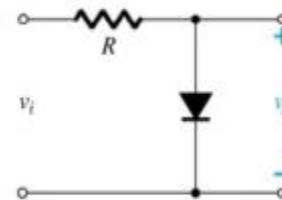
- Adding a DC source in series with the clipping diode changes the effective Forward bias of the diode.



مضيفا مصدر التيار المستمر في سلسلة مع ديود لقطة
يغير فعالية
التحيز إلى الأمام من
الصمام الثنائي.

Parallel Clippers

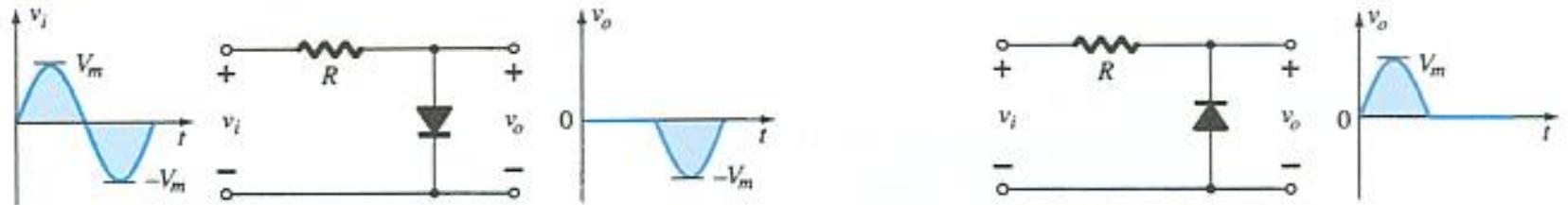
- The diode in a **parallel clipper** circuit “clips” any voltage that forward bias it.
- DC biasing can be added in series with the diode to change the clipping level.



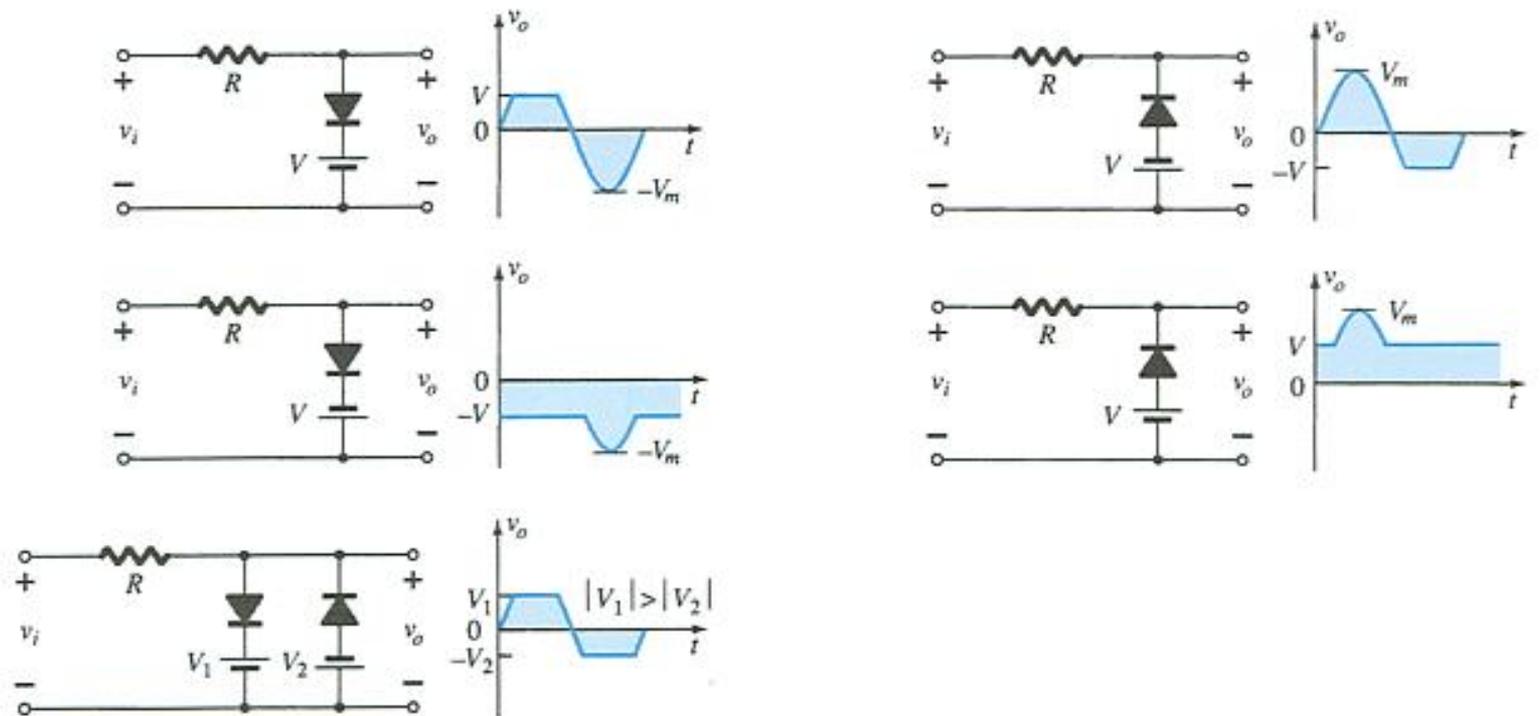
الصمام الثنائي في دائرة مجزأة متوازية "مقاطع" أي الجهد
الذي يتحيز للأمام
يمكن أن يكون DC الانحناء
وأضاف في سلسلة مع
الثنائي للتغيير
مستوى القطع

Summary of Clipper Circuits

Simple Parallel Clippers (Ideal Diodes)



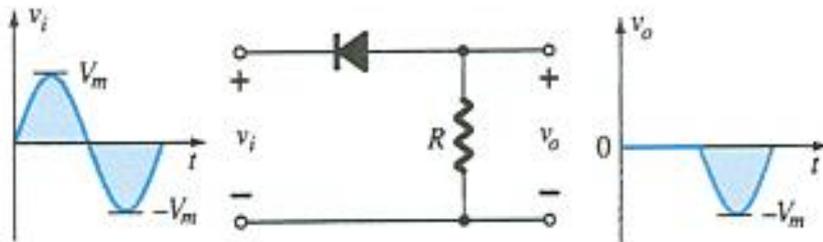
Biased Parallel Clippers (Ideal Diodes)



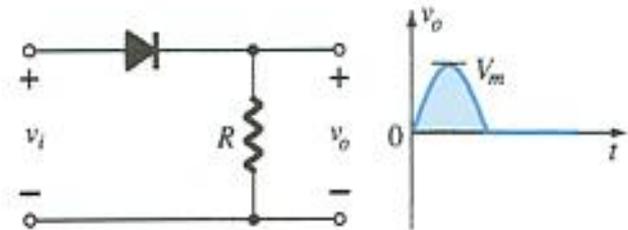
Summary of Clipper Circuits

Simple Series Clippers (Ideal Diodes)

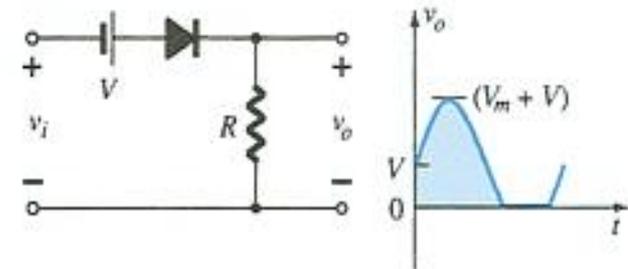
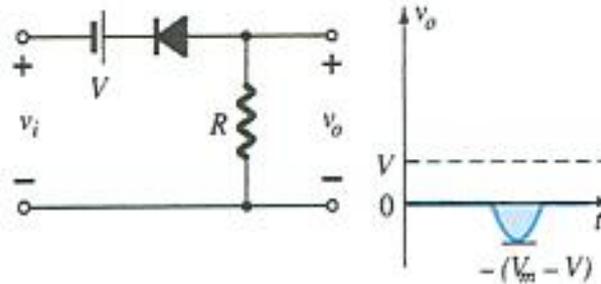
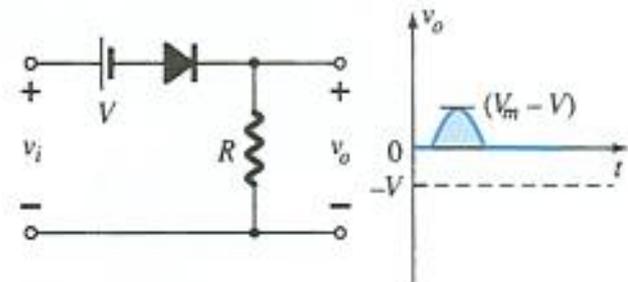
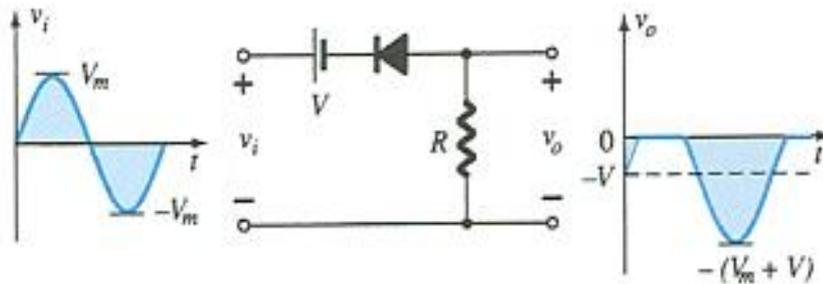
POSITIVE



NEGATIVE



Biased Series Clippers (Ideal Diodes)

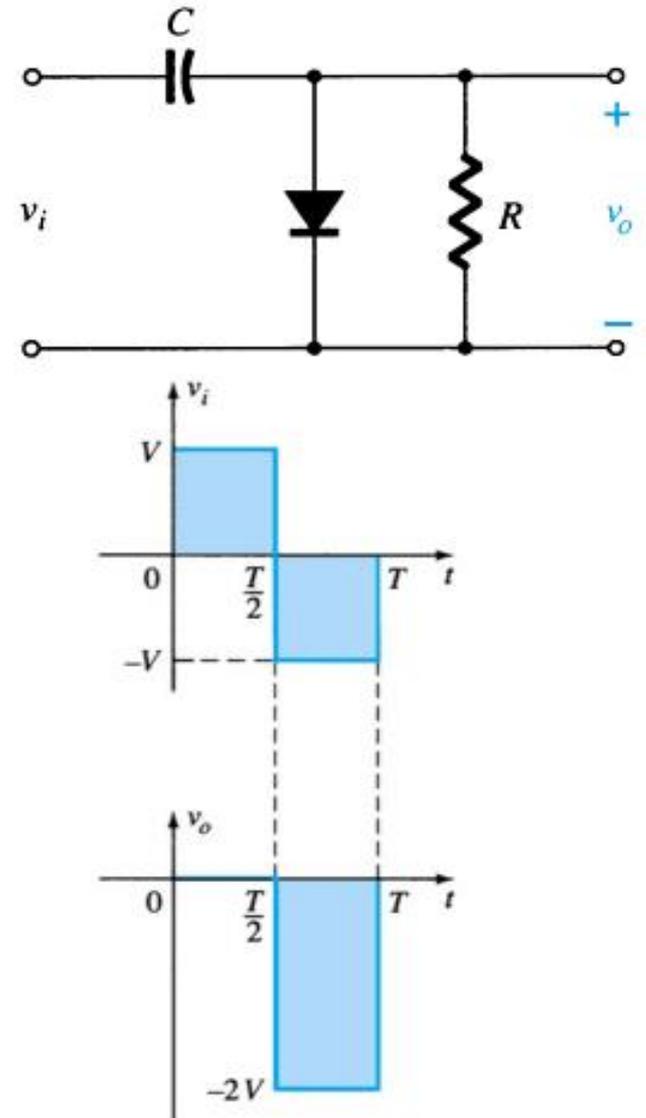


Introduction To Clippers *(Video)*



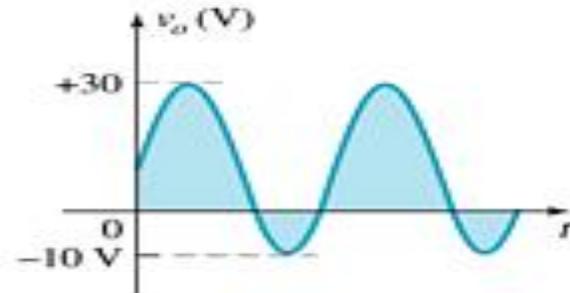
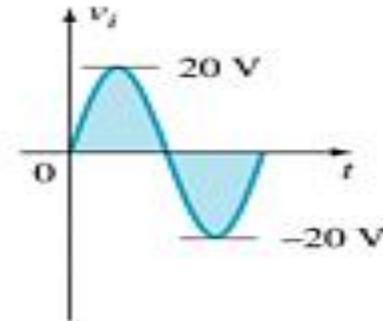
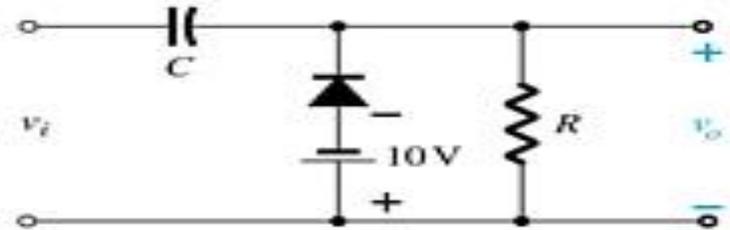
Clampers

A diode and capacitor can be combined to “clamp” an AC signal to a specific DC level.



Biased Clamper Circuits

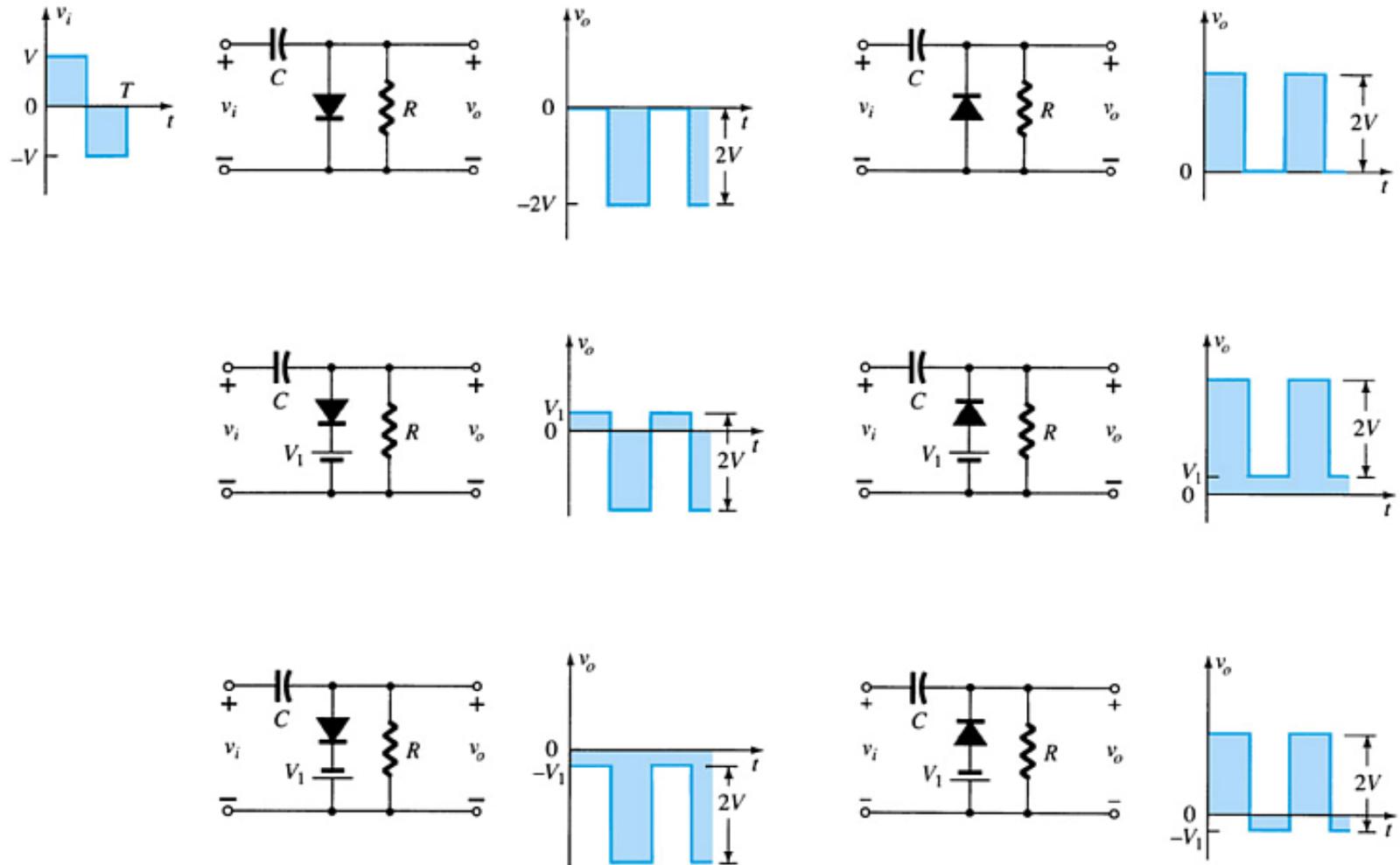
- The input signal can be any type of waveform such as sine, square, and triangle waves.
- The DC source lets you
- adjust the DC clamping level.



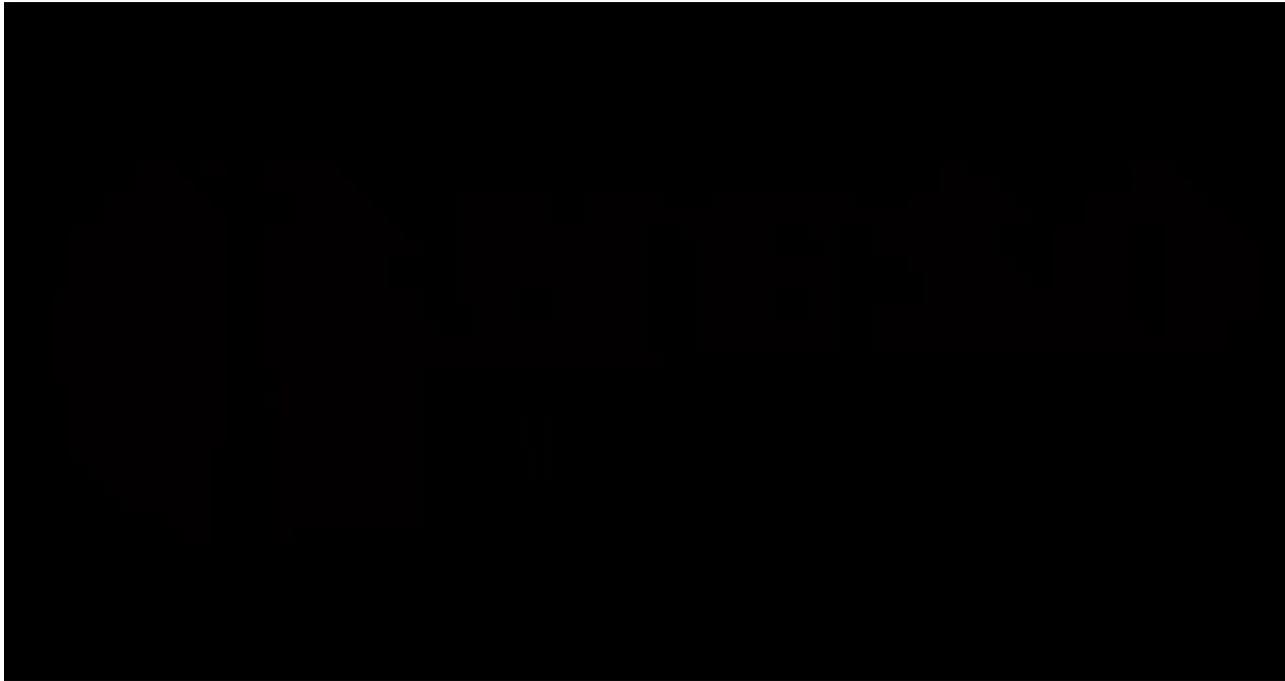
يمكن أن الصمام الثنائي ومكثف
"يتم دمجها مع "المشبيك
إلى محددة AC إشارة
DC. مستوى

Summary of Clamper Circuits

Clamping Networks



Introduction to Clampers (*Video*)



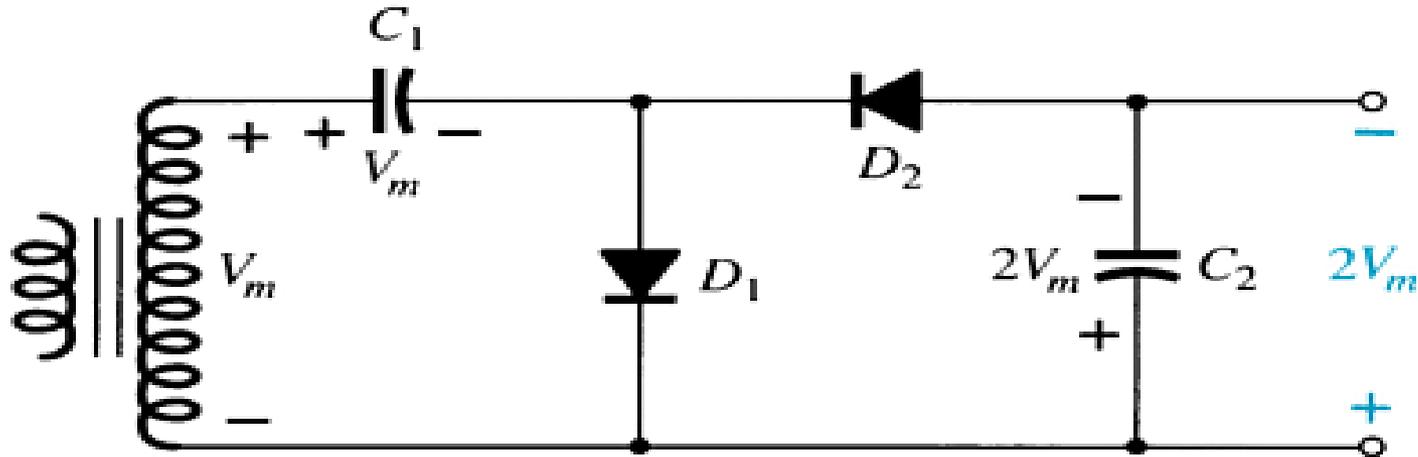
Voltage-Multiplier Circuits

Voltage multiplier circuits use a combination of diodes and capacitors to step up the output voltage of rectifier circuits.

- **Voltage Doubler**
- **Voltage Tripler**
- **Voltage Quadrupler**

تستخدم دوائر المضاعف الجهدية مجموعة
من الثنائيات والمكثفات لزيادة الجهد الناتج
من الدوائر المعدل
مضاعف الجهد
ثلاثية الجهد
الجهد الرباعي

Voltage Doubler



This half-wave voltage doubler's output can be calculated by:

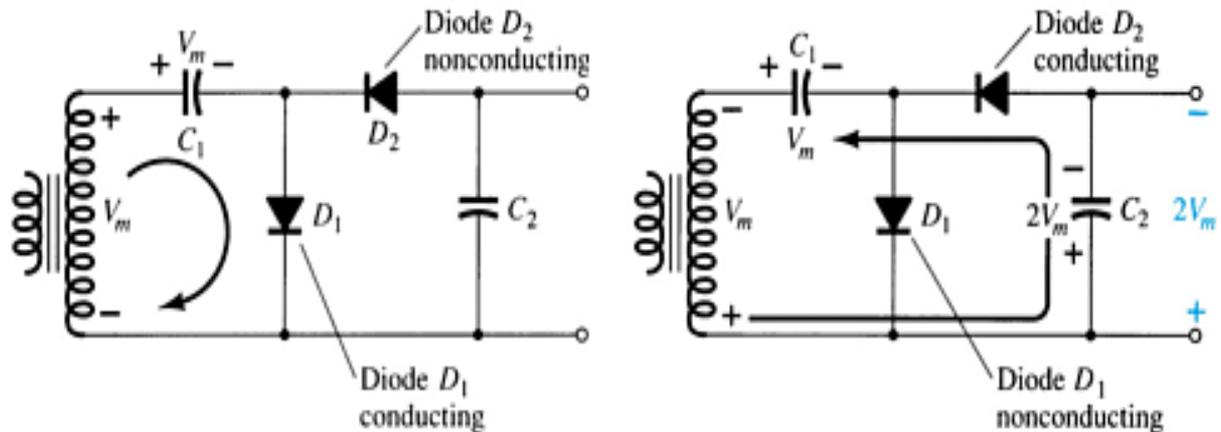
$$V_{\text{out}} = V_{C2} = 2V_m$$

where V_m = peak secondary voltage of the transformer

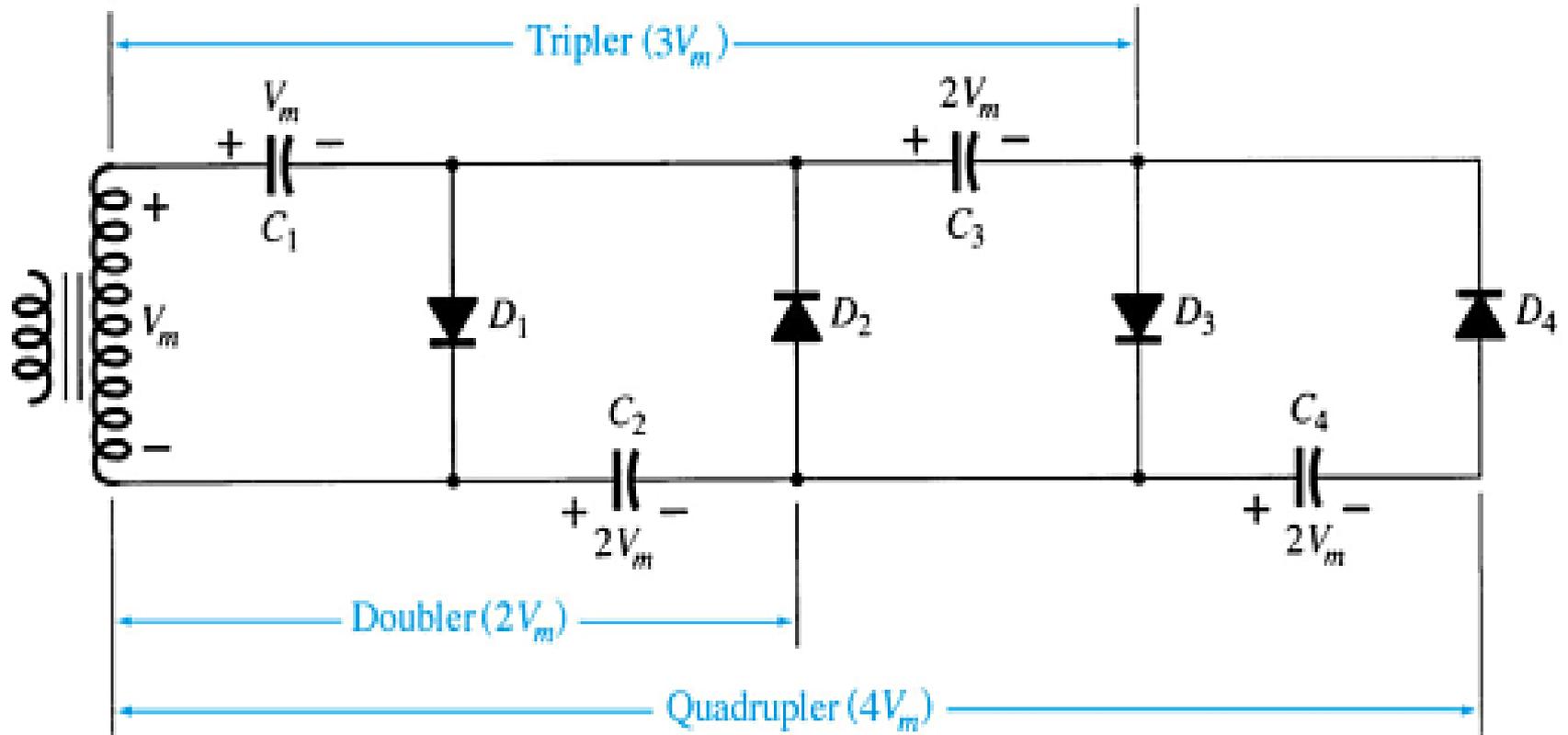
Voltage Doubler

- **Positive Half-Cycle**
 - D_1 conducts
 - D_2 is switched off
 - Capacitor C_1 charges to V_m
- **Negative Half-Cycle**
 - D_1 is switched off
 - D_2 conducts
 - Capacitor C_2 charges to V_m

$$V_{\text{out}} = V_{C_2} = 2V_m$$



Voltage Tripler and Quadrupler



Voltage Multiplier Video



Practical Applications

- **Rectifier Circuits**

- **Conversions of AC to DC for DC operated circuits**
- **Battery Charging Circuits**

- **Simple Diode Circuits**

- **Protective Circuits against**
- **Overcurrent**
- **Polarity Reversal**
- **Currents caused by an inductive kick in a relay circuit**

- **Zenar Circuits**

- **Overvoltage Protection**
- **Setting Reference Voltages**
- **Voltage regulator.**

تطبيقات عملية

الدوائر المعدل
للدوائر المشغلة بالتيار المستمر DC إلى AC تحويل
دارات شحن البطارية

دوائر ديود بسيطة
الدوائر الواقية ضد
التيار الزائد
قطبية عكس
التيارات الناجمة عن ركلة استكشافية في دائرة التتابع

دوائر زينار
الحماية من الفولت الزائد
وضع الفولتية المرجعية
منظم ضغط كهربى

Queries