Analog Electronics Circuits

18EI31

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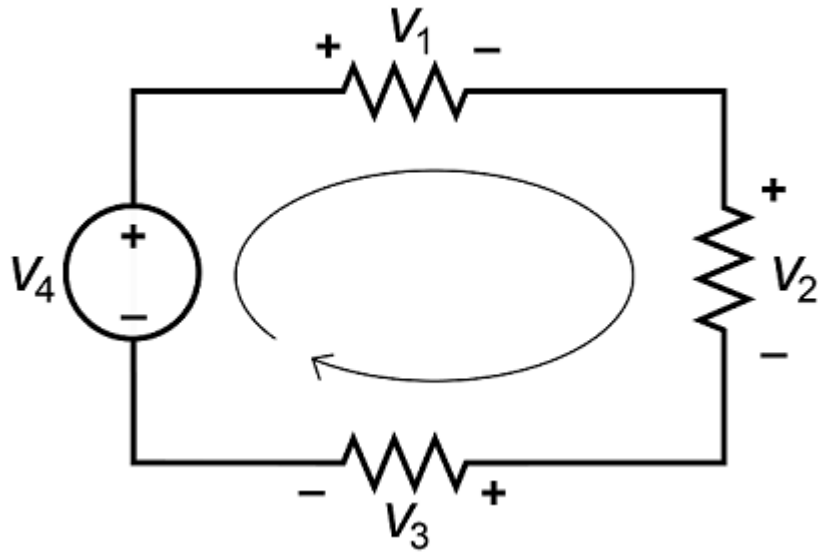
DR AIT

Kirchhoff's Voltage Law

The algebraic sum of all the voltages around any closed loop in a circuit is equal to zero



$$-V1-V2+V3+V4=0$$

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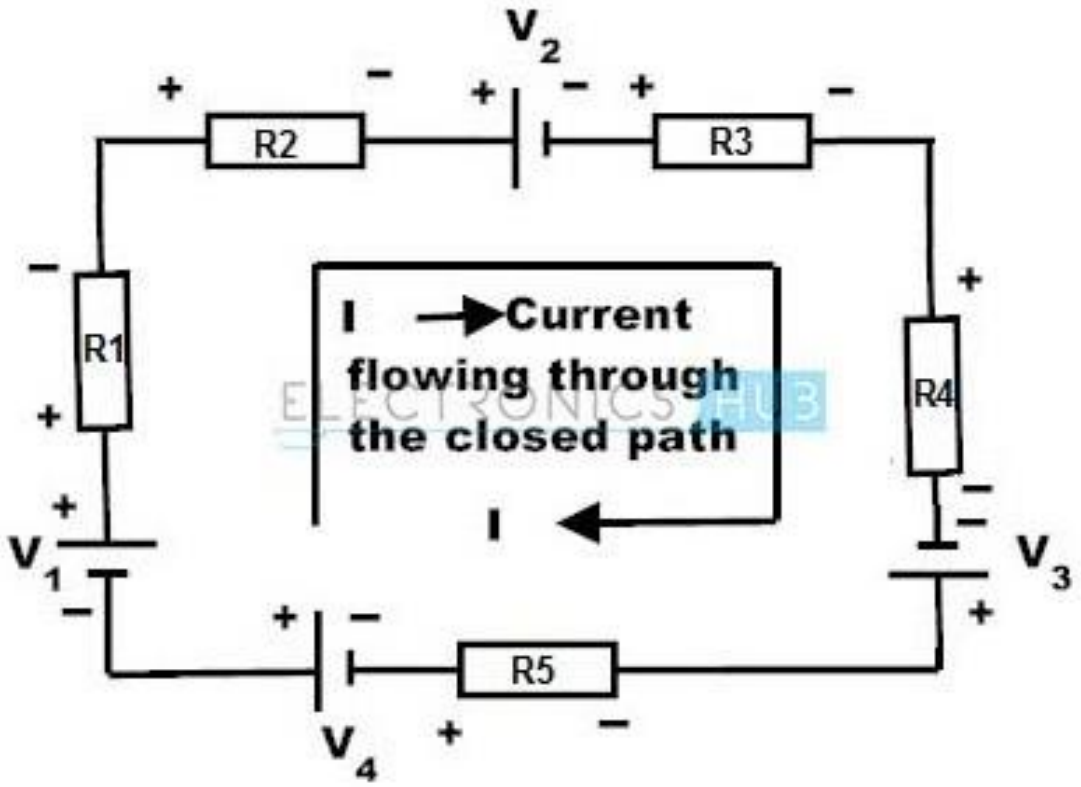
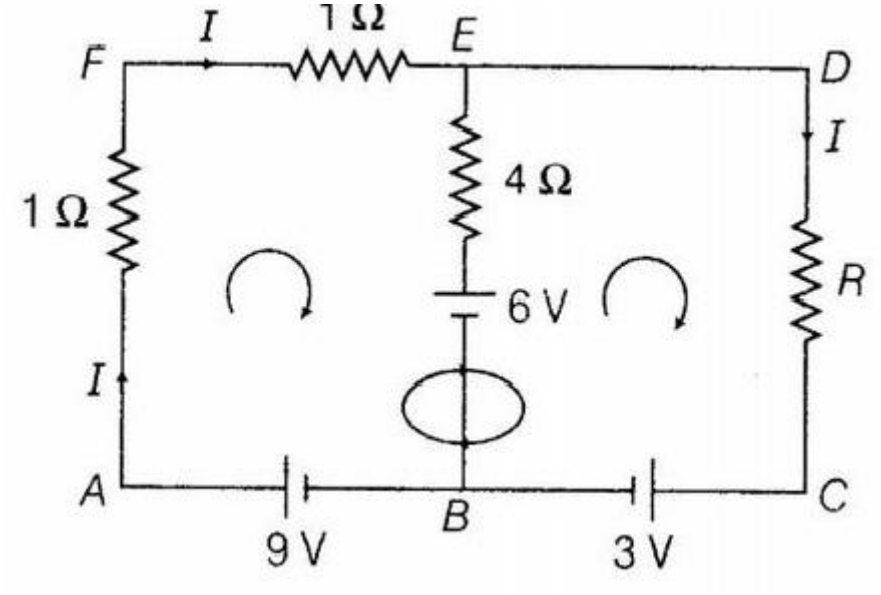


V1-IR1-IR2-V2-IR3-IR4+V3+IR5+V4=0

Continued..



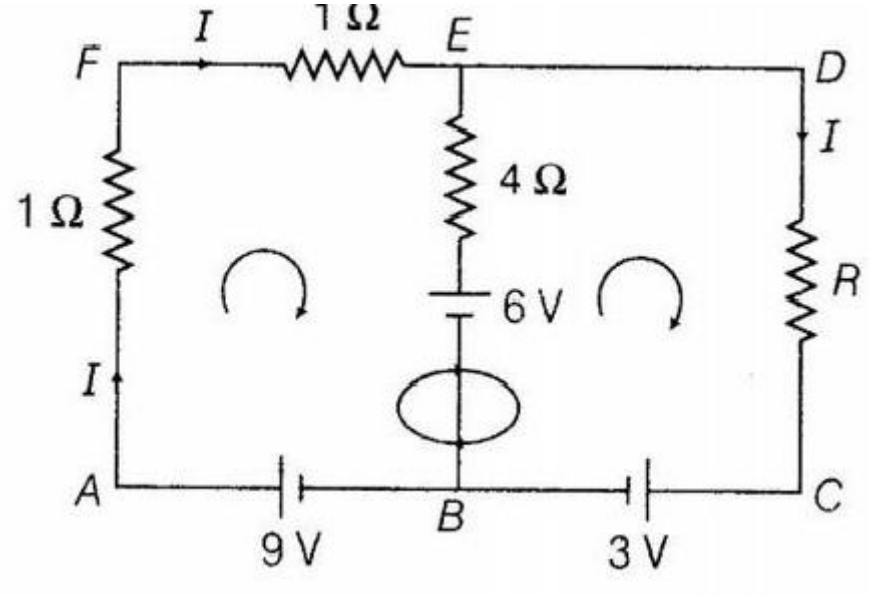
Applying Kirchhoff's IInd law in mesh *AFDCA*

$$-1\times I-1\times I-I\times R-3+9=0$$

$$-2I-IR+6=0$$

$$2I+IR=6$$

Continued..



Applying Kirchhoff's second law in mesh *AFEBA*

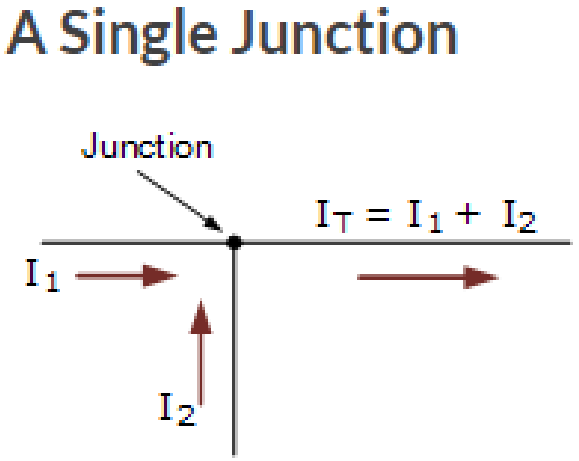
$$-1\times I-1\times I-6+9=0$$

$$-2I+3=0$$

$$I=\frac{3}{2}\text{ A}$$

Kirchhoff's Current Law

The total current entering a circuits junction is exactly equal to the total current leaving the same junction.



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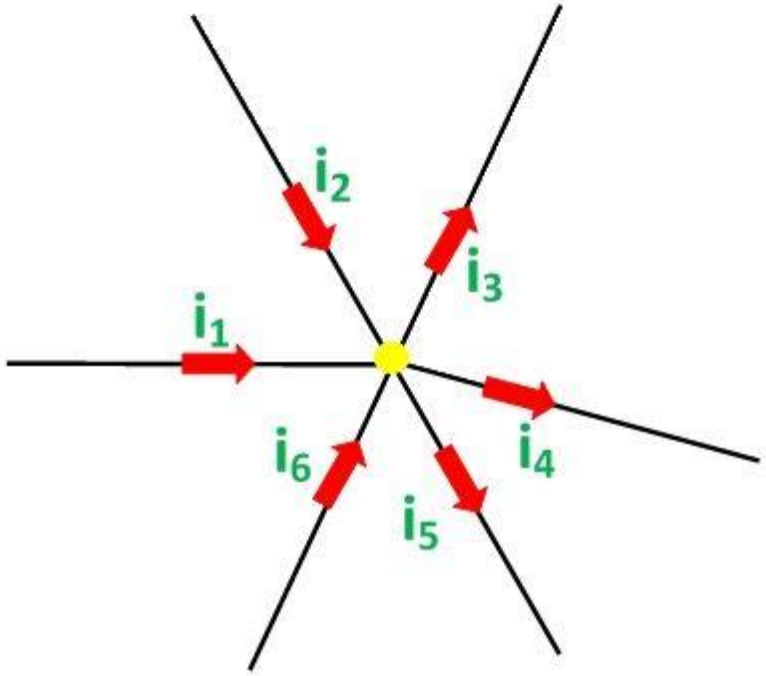
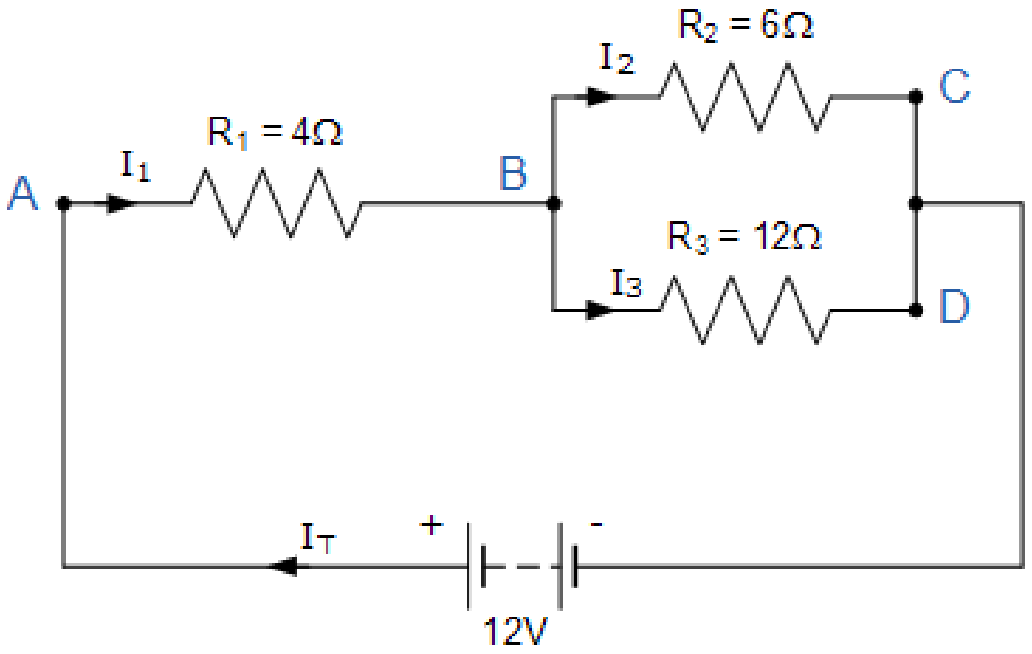


$$i_1 + i_2 - i_3 - i_4 - i_5 + i_6 = 0$$

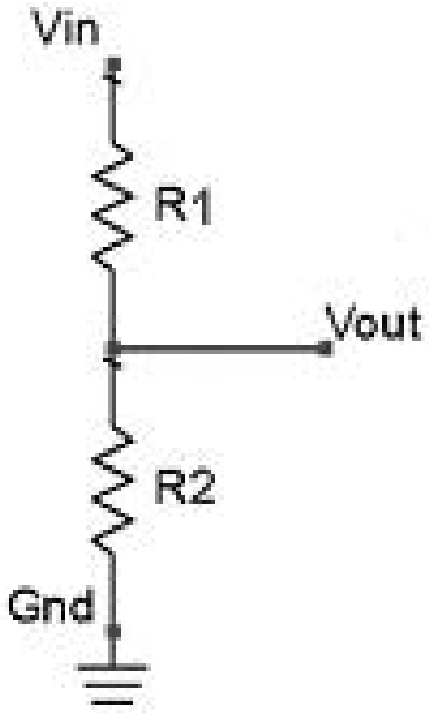
Continued..



Loop ABC $\Rightarrow$ $12 = 4I_1 + 6I_2$

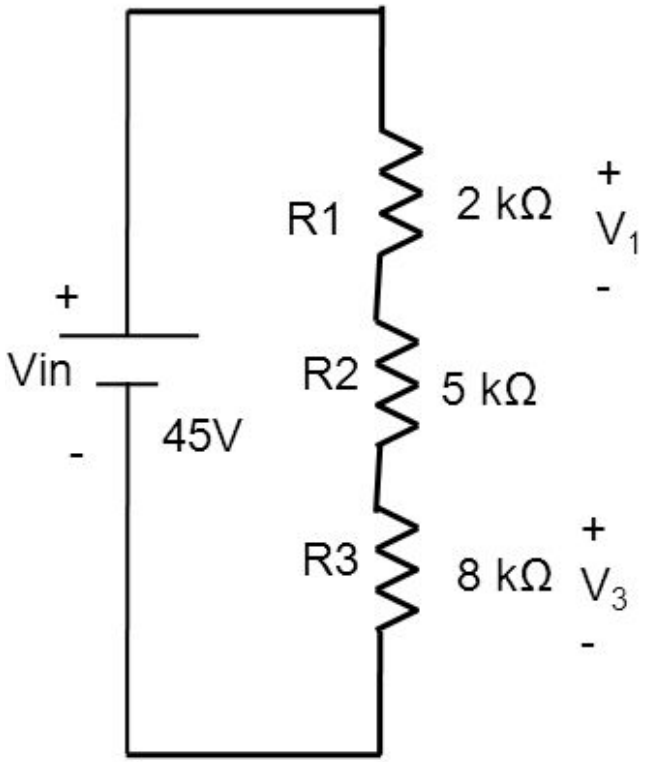
Loop ABD $\Rightarrow$ $12 = 4I_1 + 12I_3$

Voltage Divider Rule



$$V_{out} = V_{in} \cdot \frac{R_2}{R_1 + R_2}$$

Continued..



$$V_1 = \frac{R_1 V_{in}}{R_T}$$

$$\frac{(2k\Omega)(45V)}{2k\Omega + 5k\Omega + 8k\Omega} = \frac{(2k\Omega)(45V)}{15k\Omega}$$

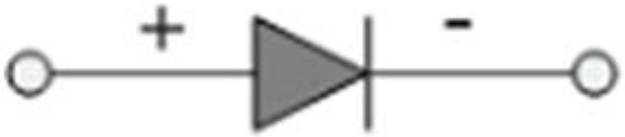
$$= 6V$$

$$V_3 = \frac{R_3 V_{in}}{R_T}$$

$$= 24V$$

Ideal Diode

Forward Biased



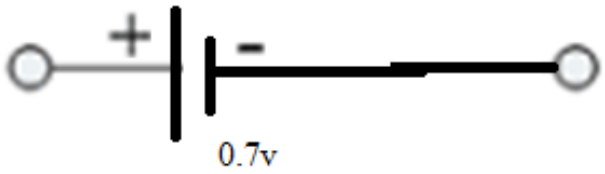
Forward Bias
(switch closed)

Reversed Biased

Reverse Bias
(switch open)

Silicon Diode

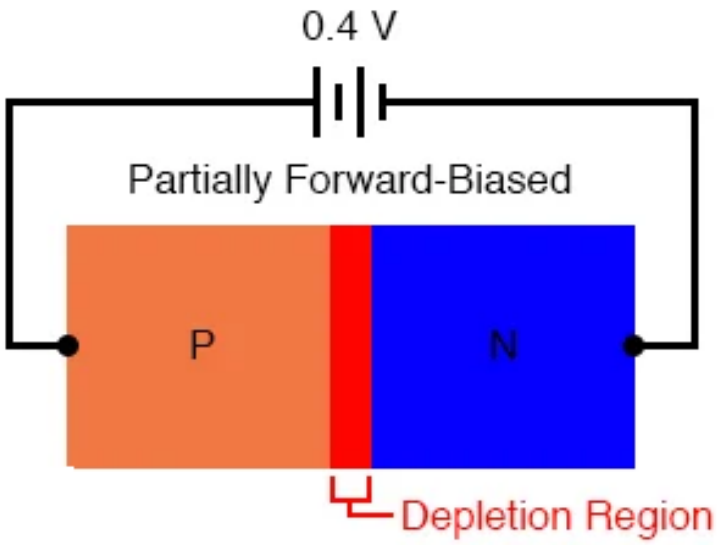
Forward Biased

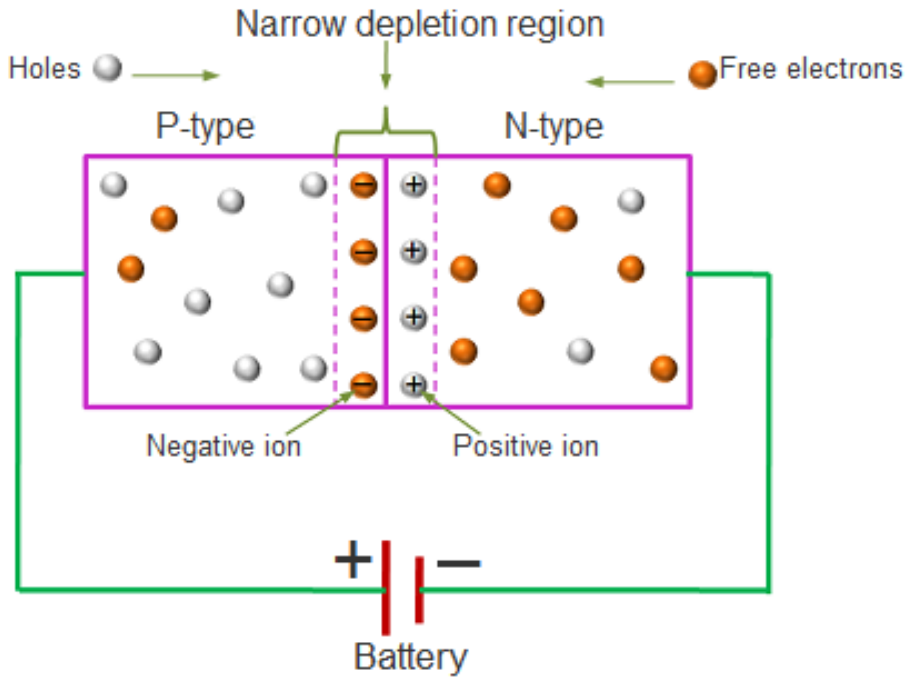


Reversed Biased

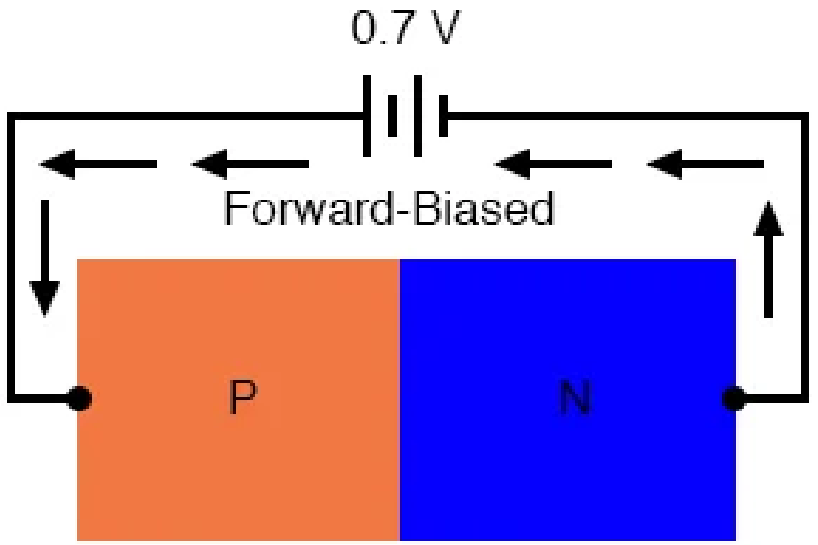
Reverse Bias
(switch open)

Forward Bias



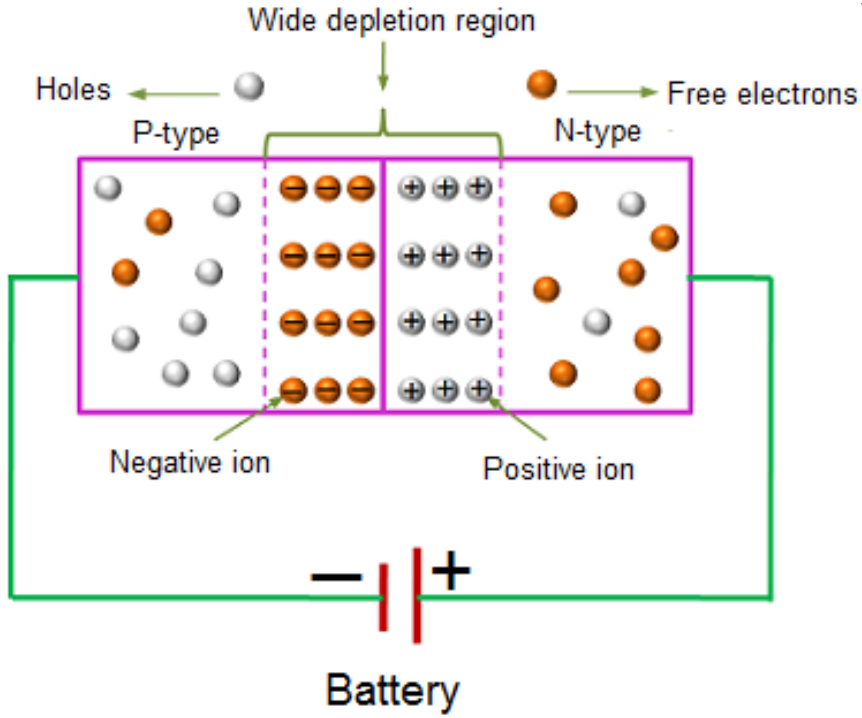


Forward bias



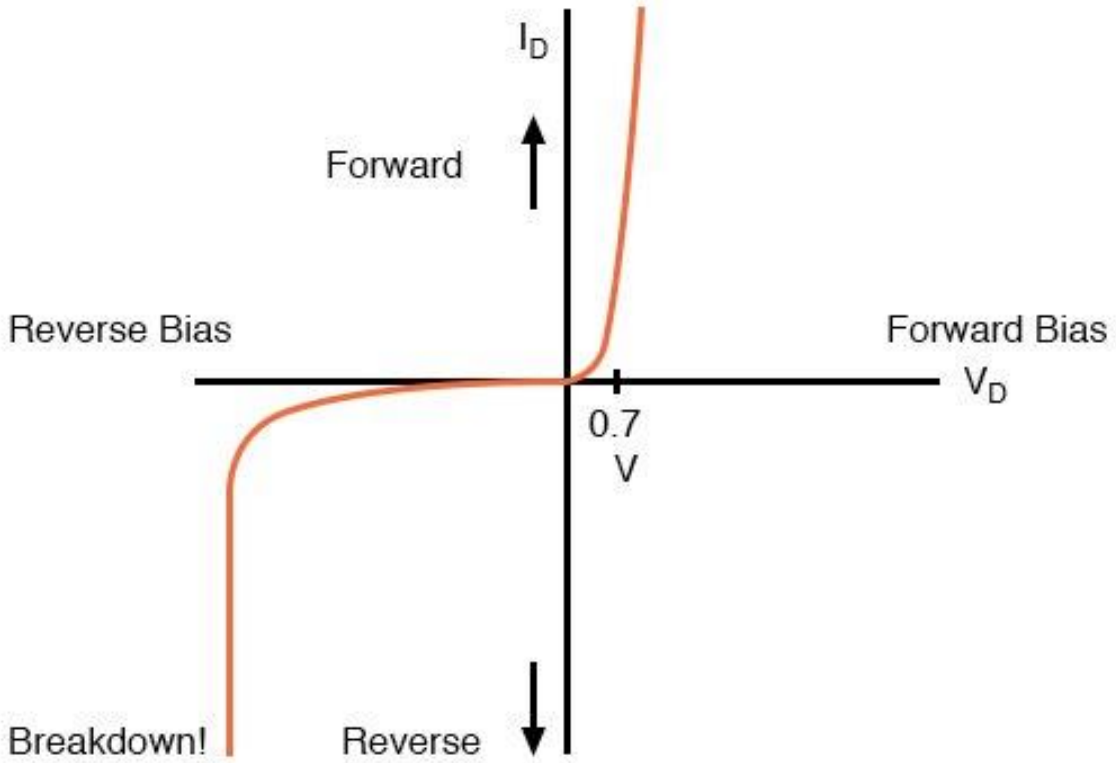
Depletion Region Fully Collapsed

Reverse Bias

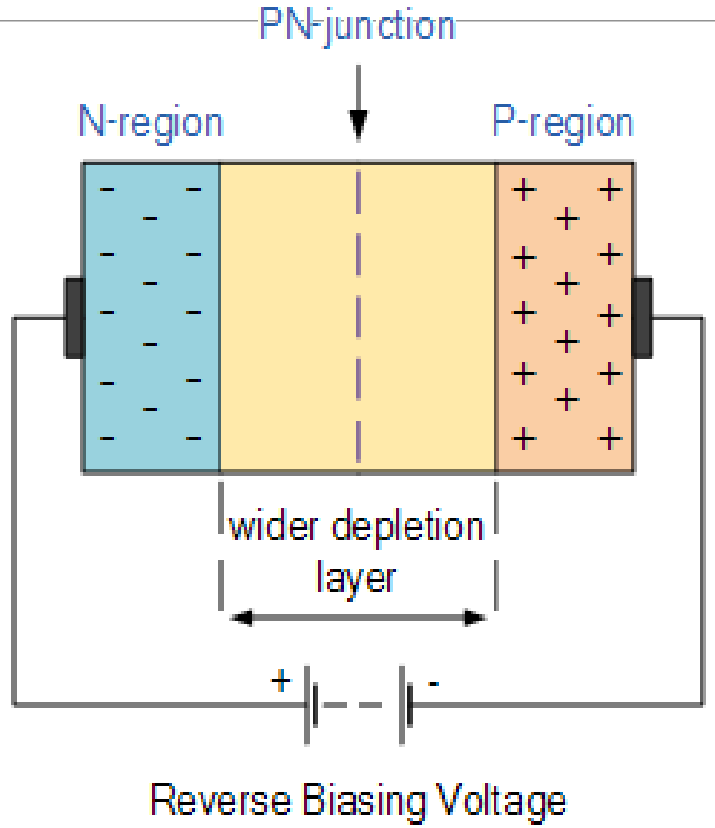


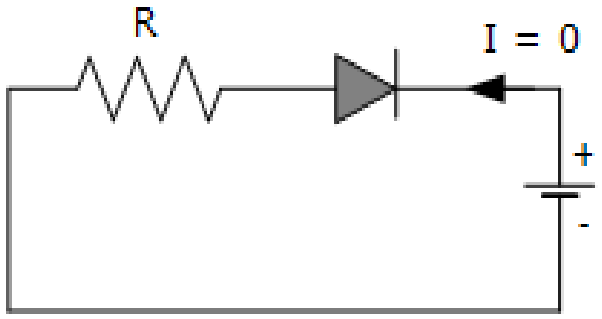
Reverse bias

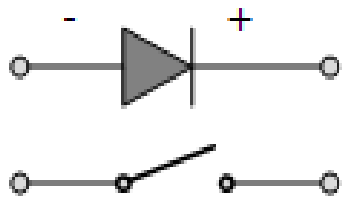
Characteristics

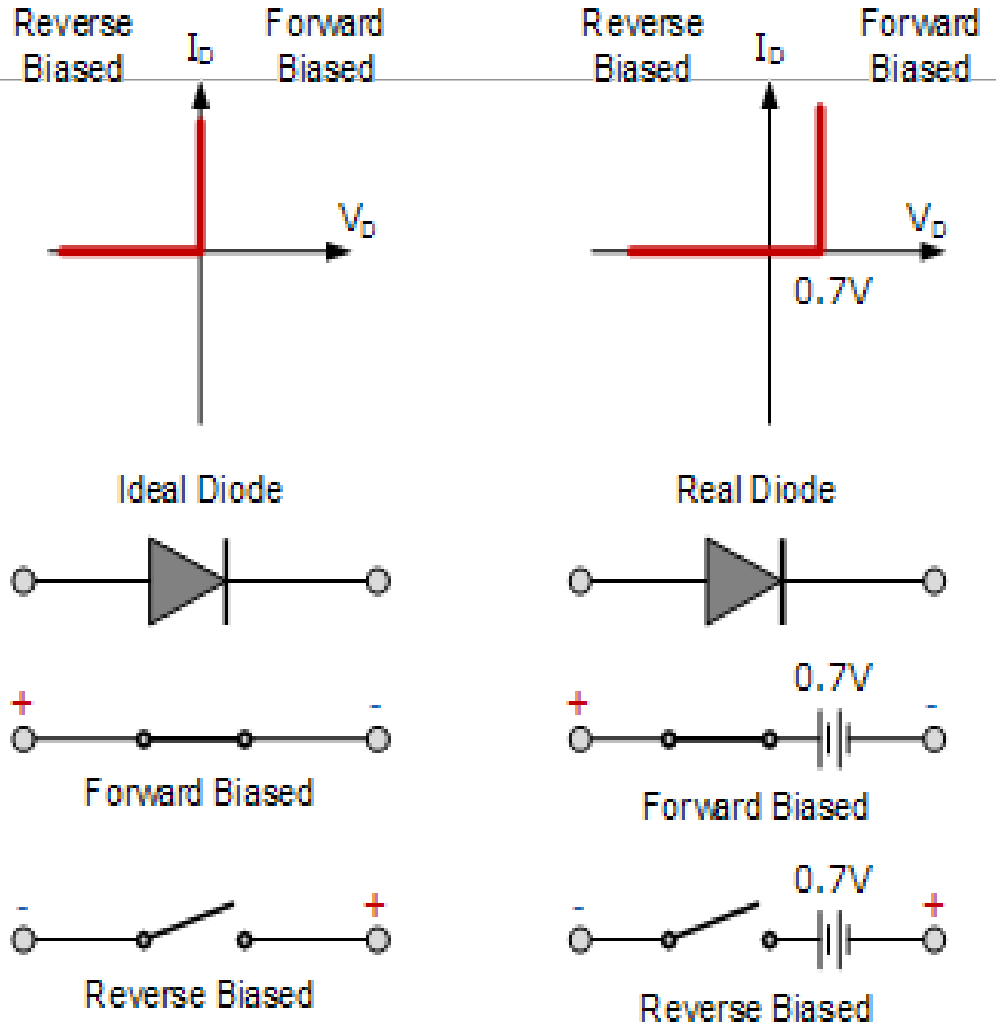


Reverse Bias

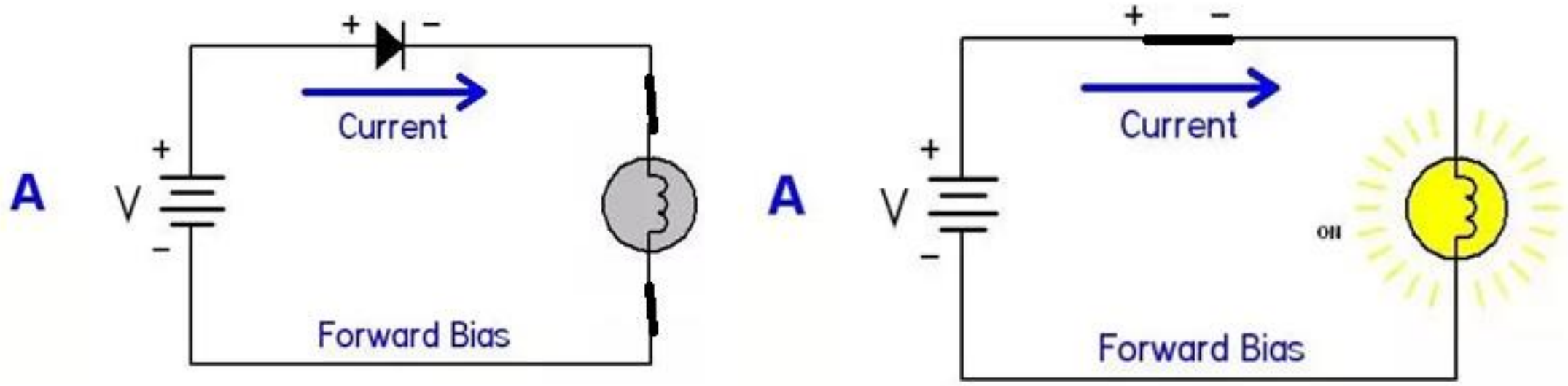




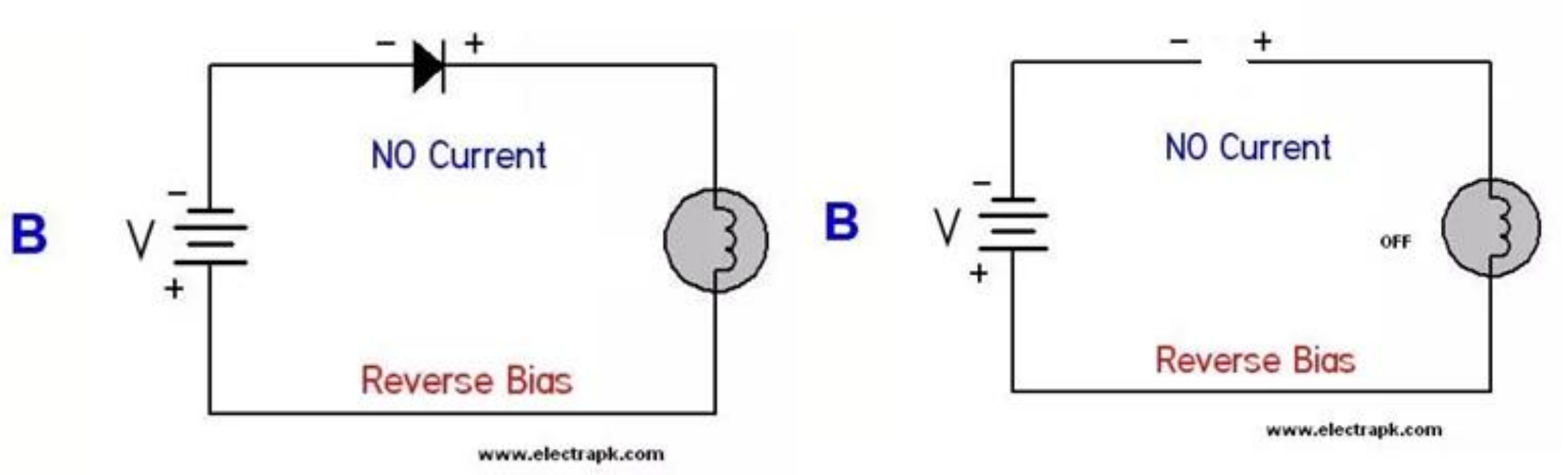


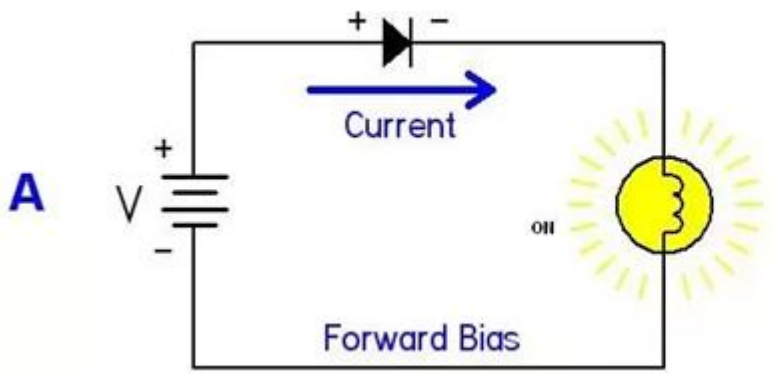

Reverse Biased
I_D
Forward Biased
V_D
Ideal Diode
+
-
Forward Biased
-
+
Reverse Biased
Reverse Biased
I_D
Forward Biased
V_D
0.7V
Real Diode
0.7V
+
-
Forward Biased
0.7V
-
+
Reverse Biased

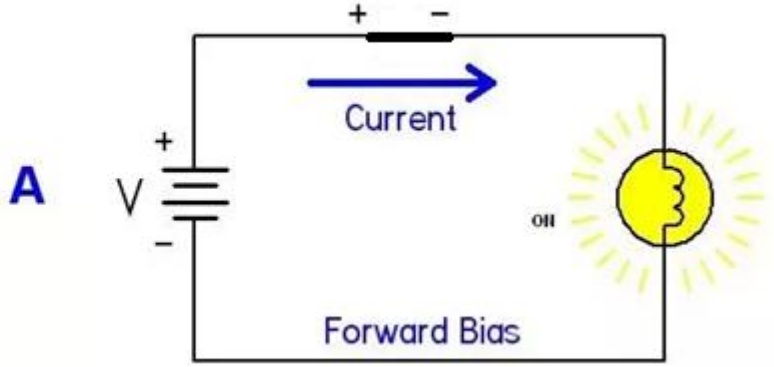
Example

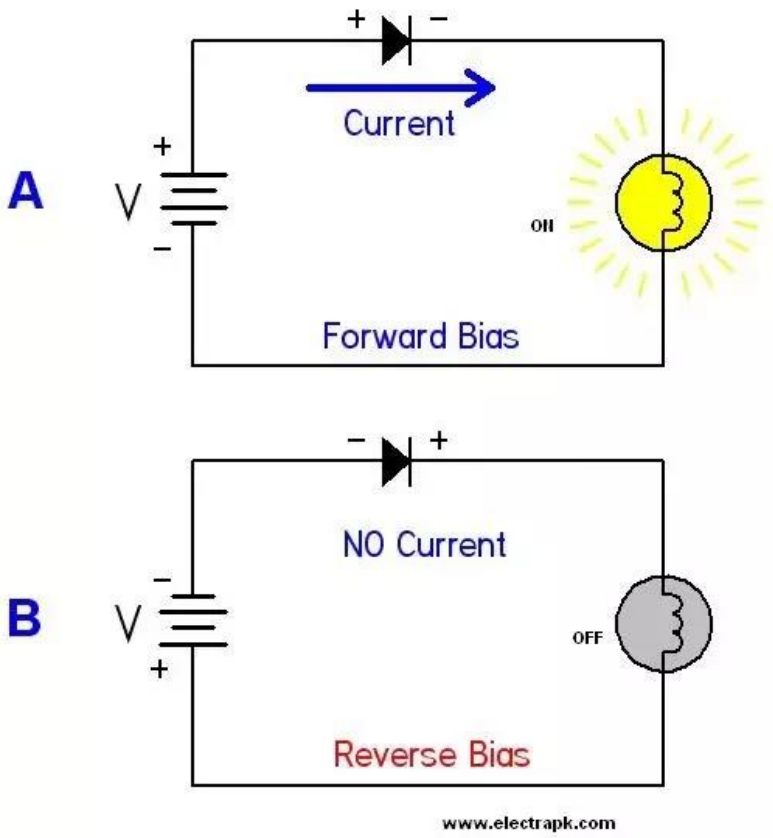


Example


B
V
NO Current
Reverse Bias
www.electrapk.com
B
V
NO Current
OFF
Reverse Bias
www.electrapk.com


+
–
Current
A
V
+
–
OH
Forward Bias


+
–
Current
A
V
+
–
OH
Forward Bias


A
+
−
Current
+
V
−
ON
Forward Bias
B
−
+
NO Current
−
V
+
OFF
Reverse Bias
www.electrapk.com

Diode Clipper

A clipper is a type of diode network that has the ability to "clip off" a portion of the input signal without distorting the remaining part of the alternating waveform.

Types of Clipper: series clippers, shunt clippers and dual (combination) clippers.

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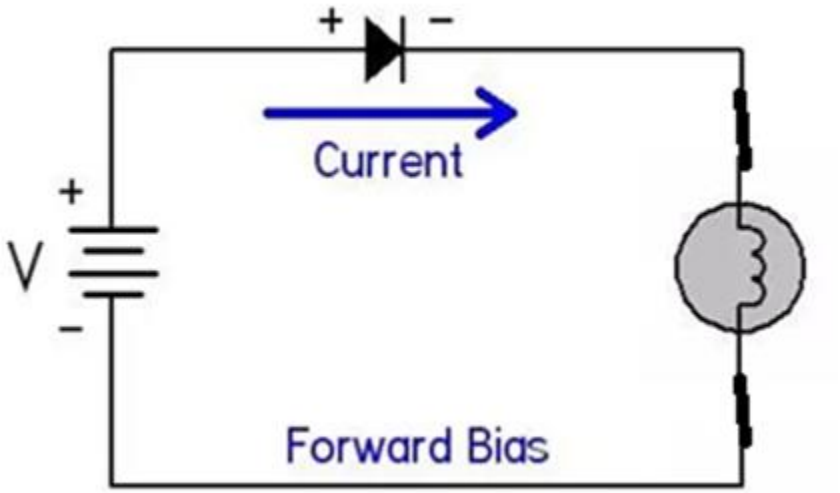
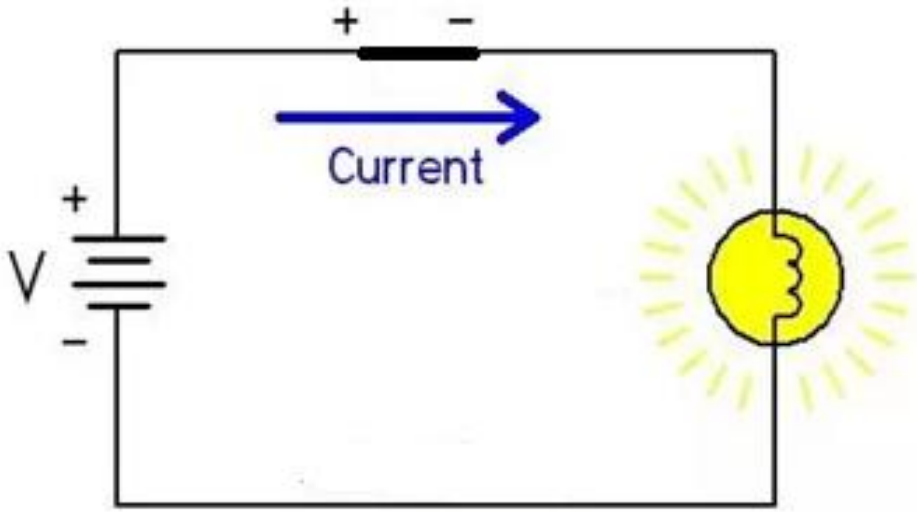
Series clippers: the **diode** is connected in **series** with the output load resistance.

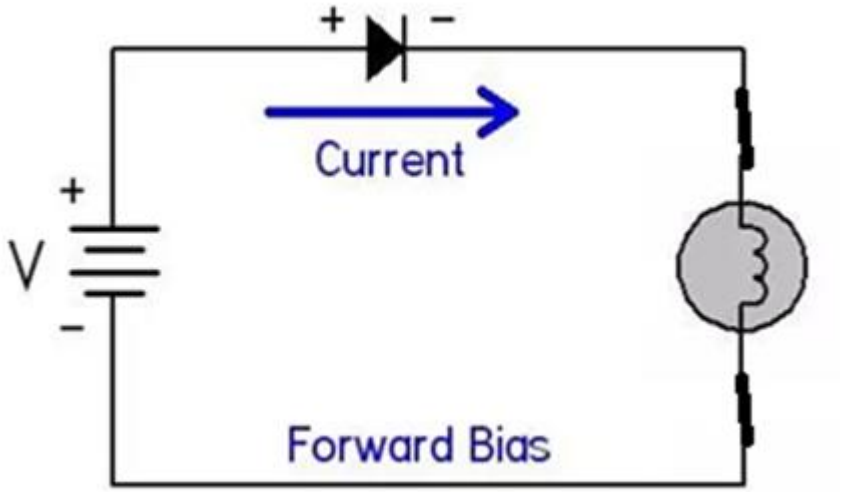
Shunt clippers: the **diode** is connected in parallel with the output load resistance.

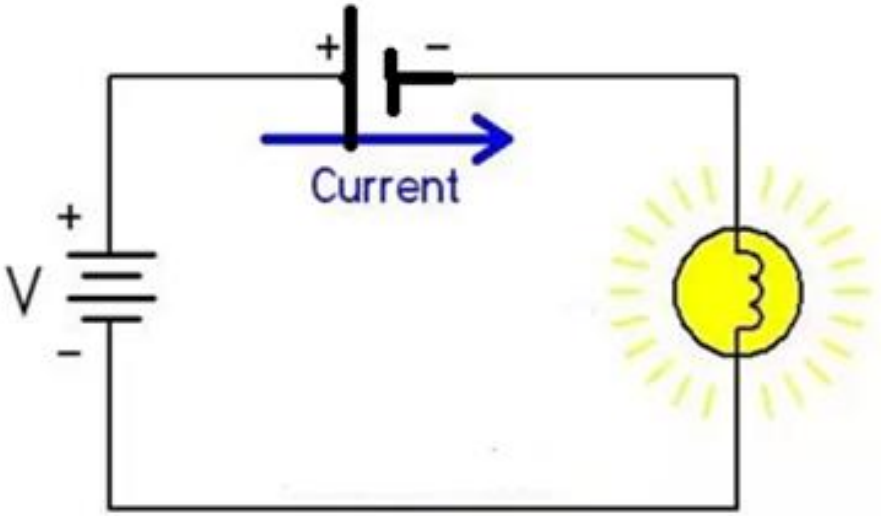
Ideal Diode



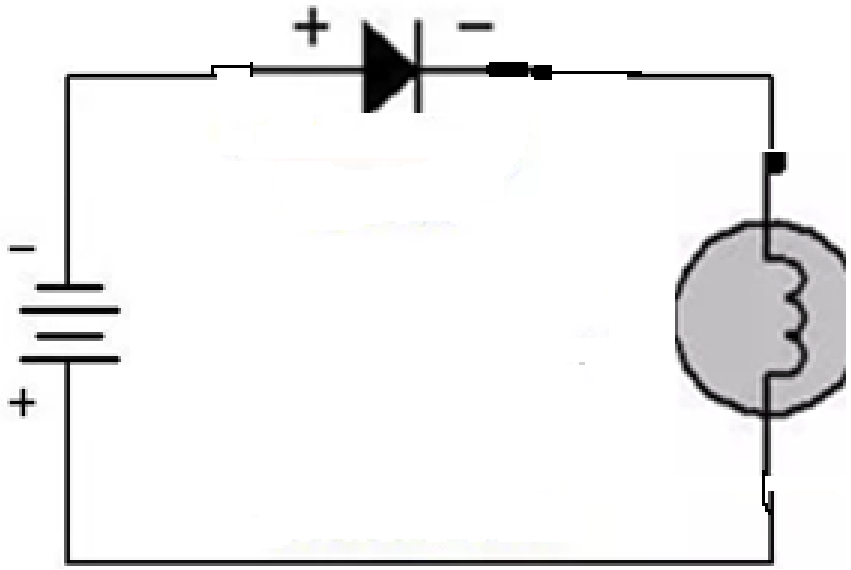


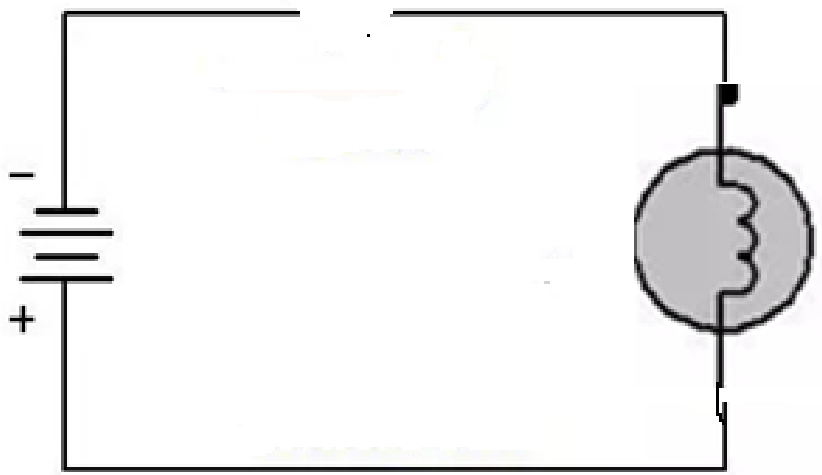
Silicon Diode



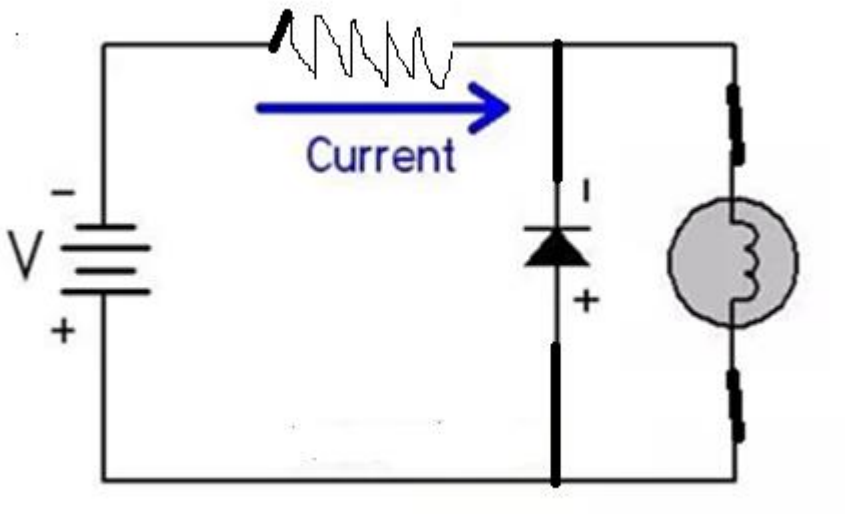


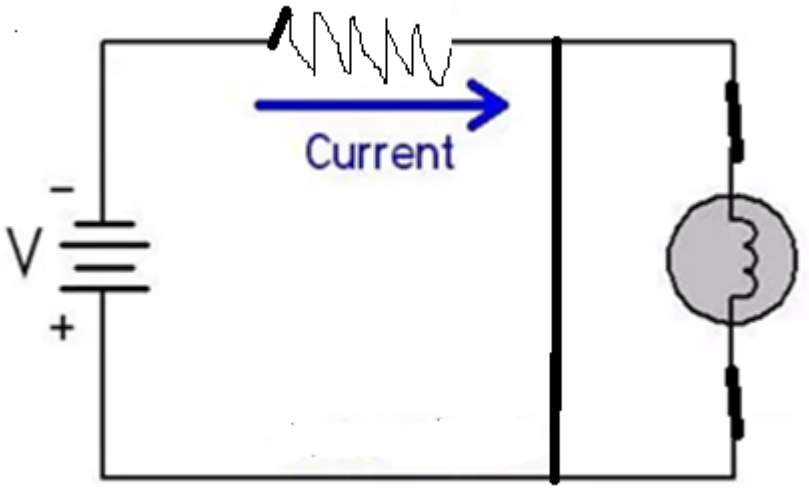
Example

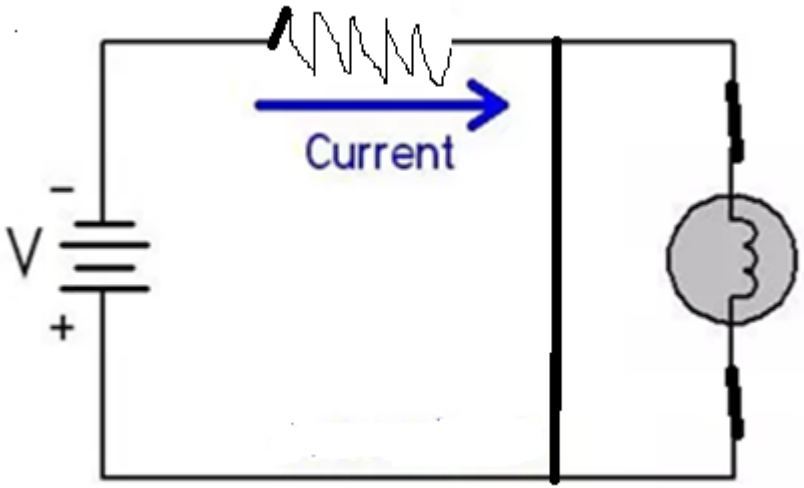


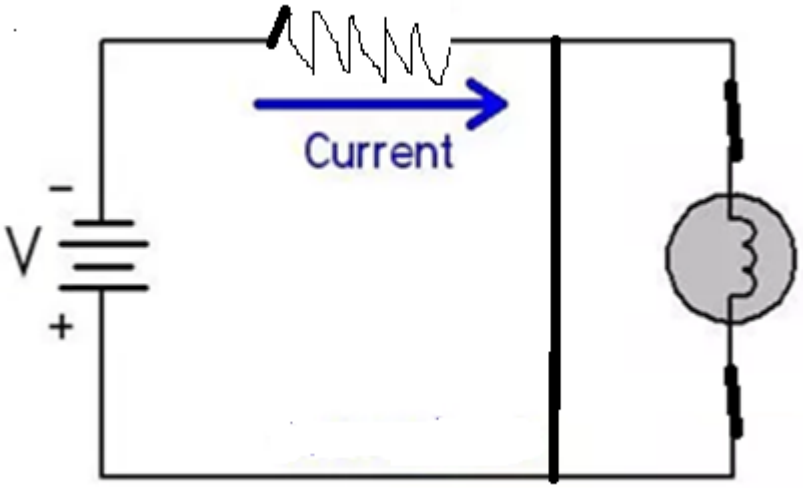


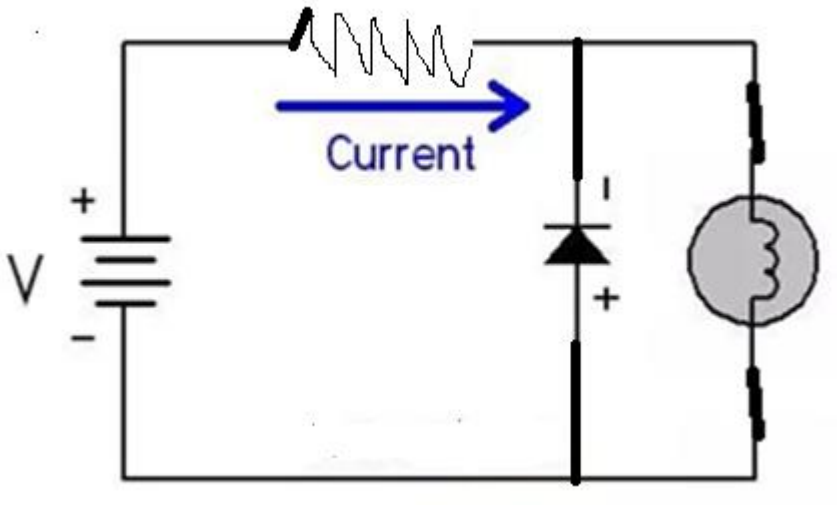
Ideal Diode

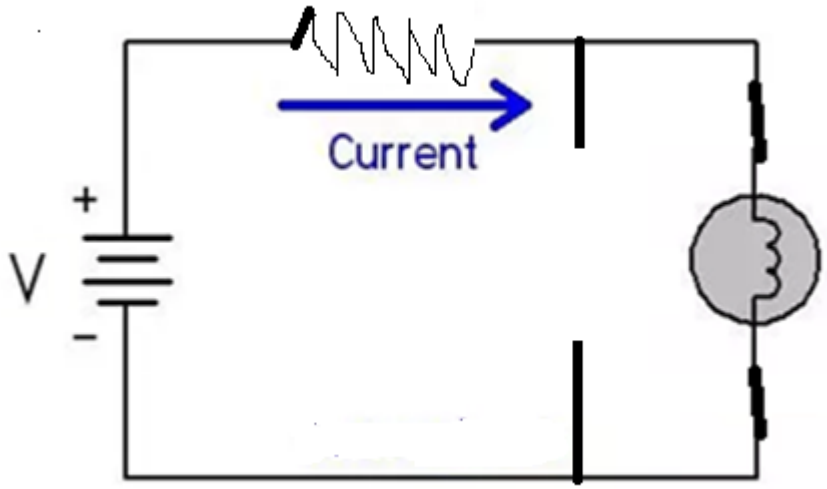


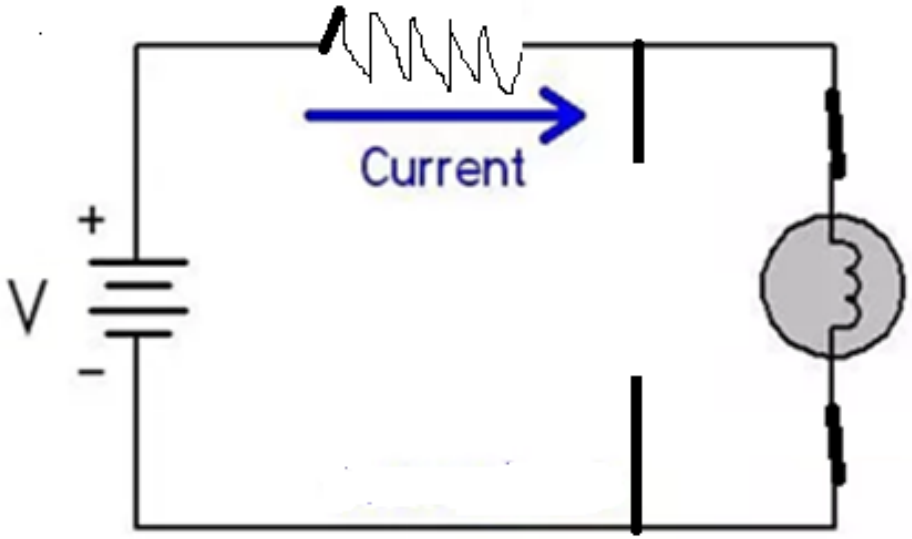


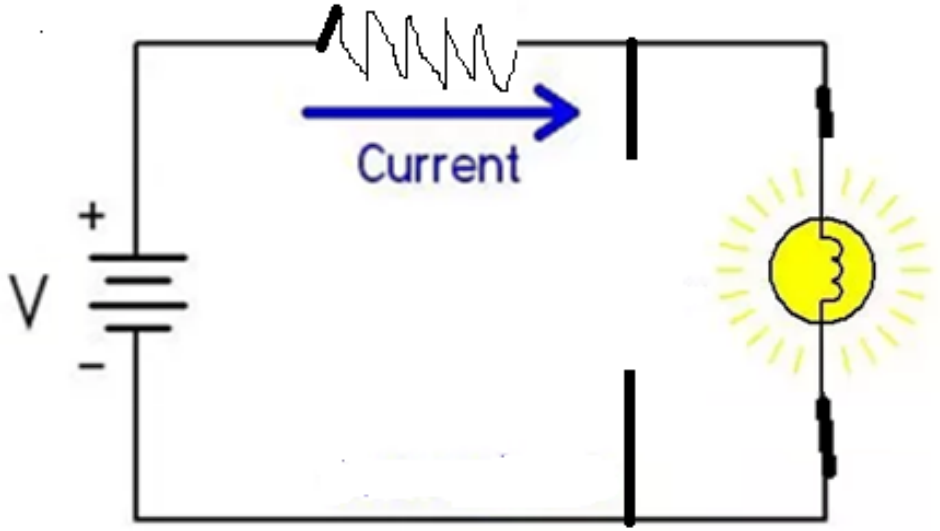

Current
V
–
+


Current
V
–
+

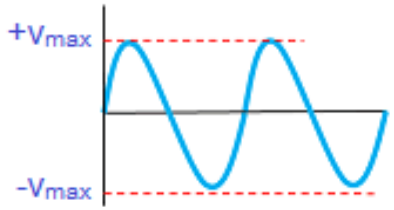

Current
+
V
–
+


Current
+
V
–

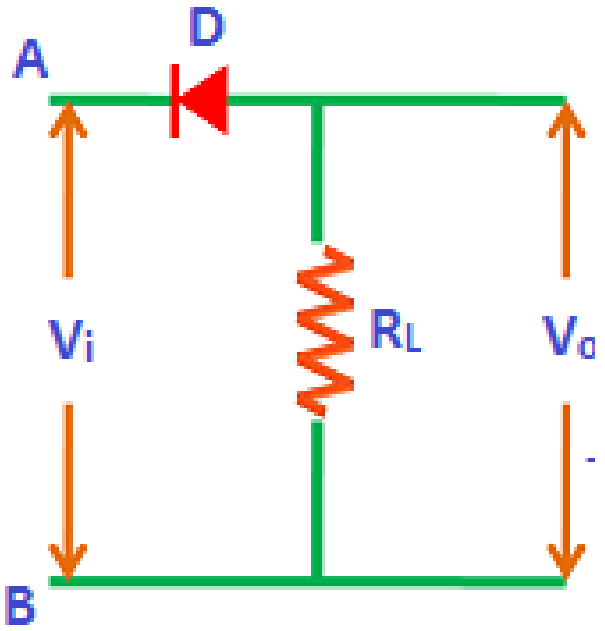

Current
+
V
–

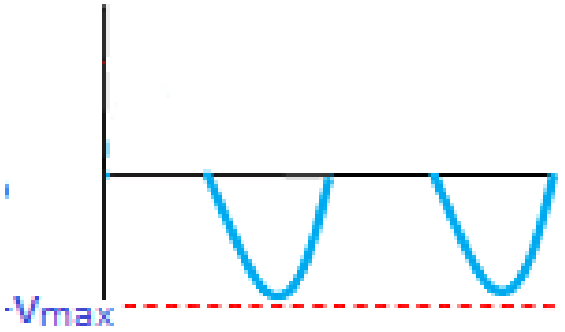

Current
+
V
–

Series clippers



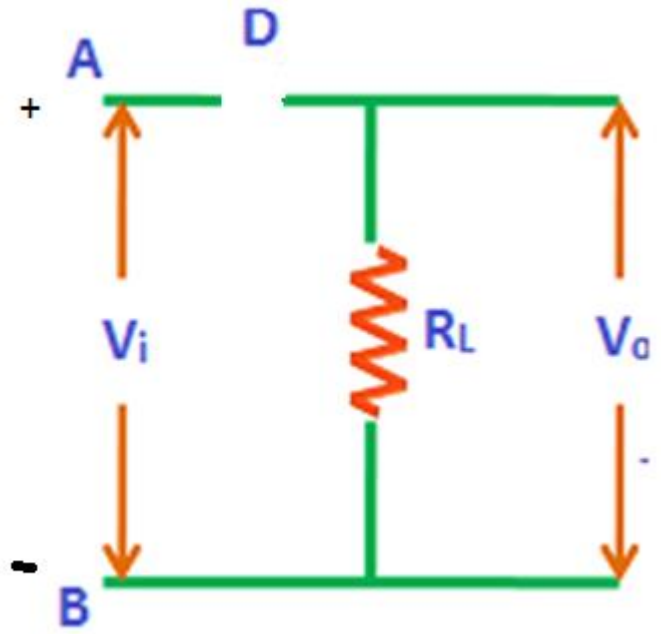
Input waveform



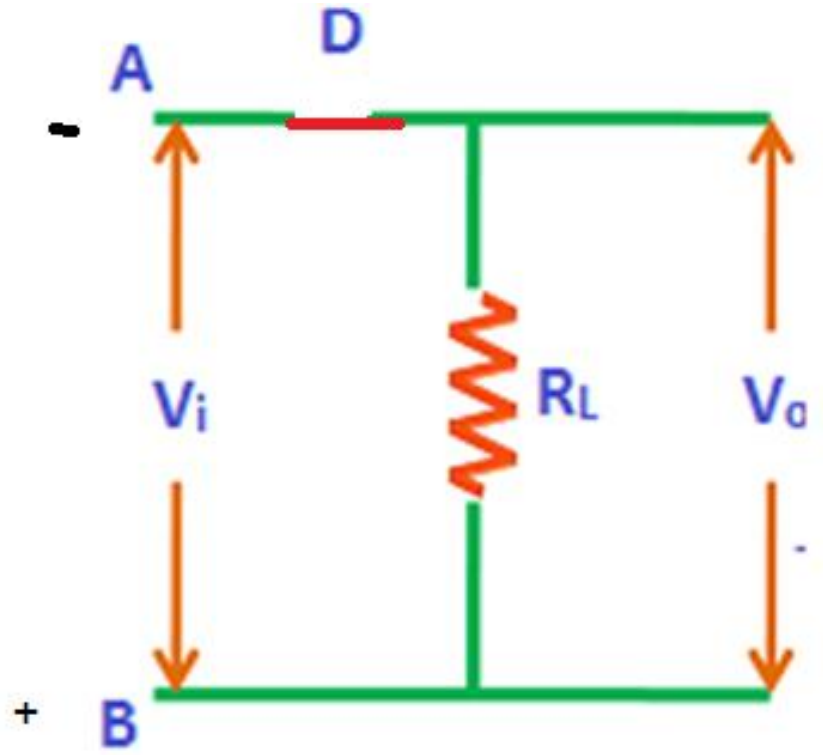


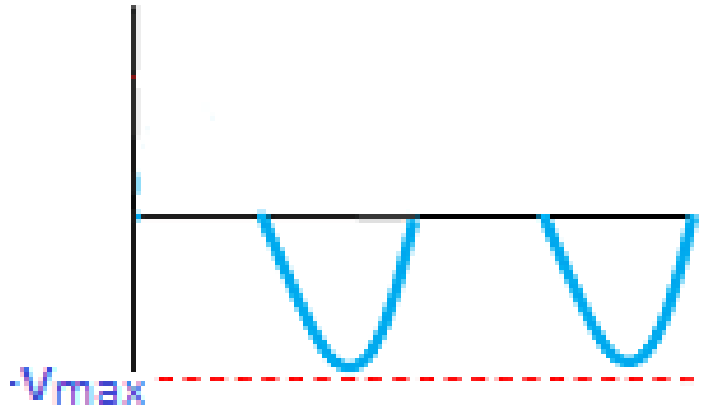
Output waveform

Positive Half Cycle



Negative Half Cycle





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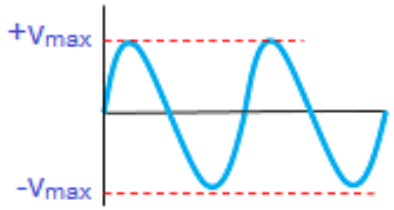
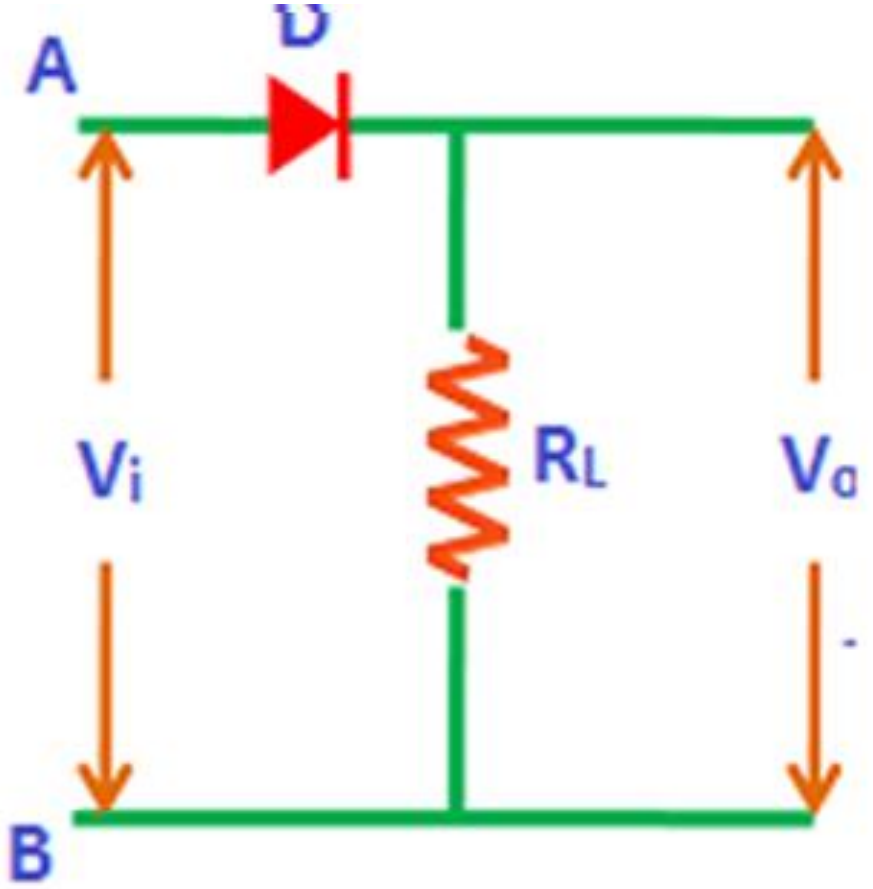


Input waveform



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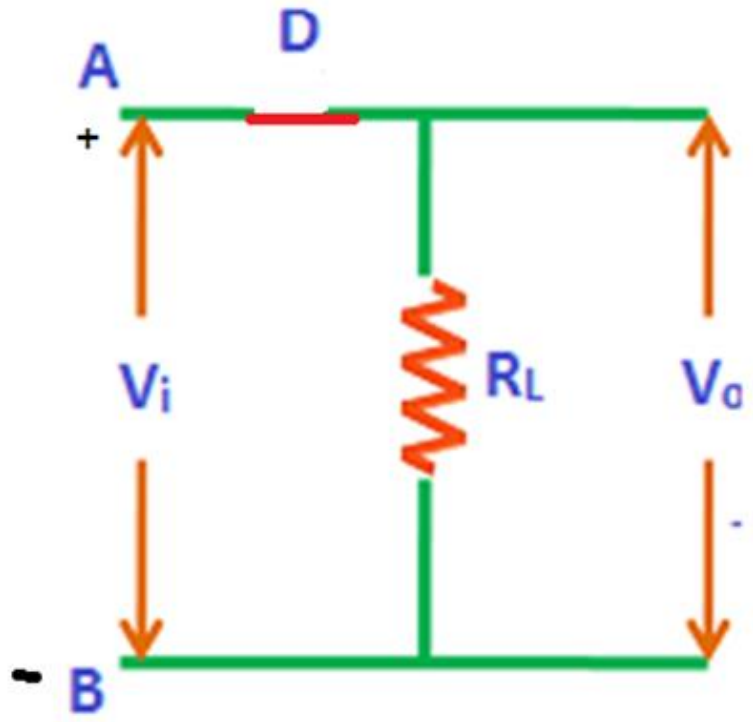
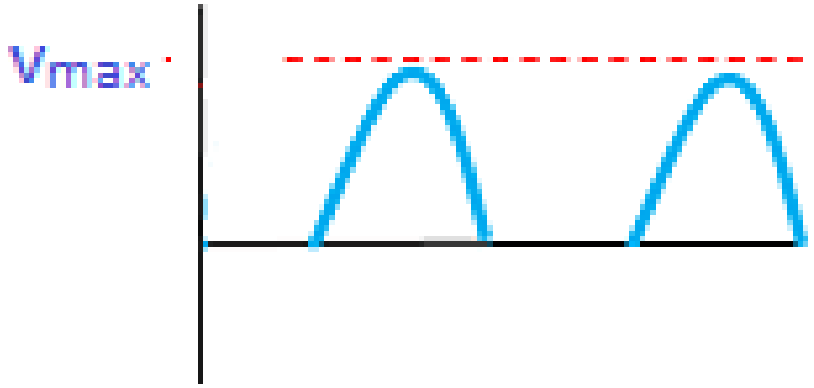
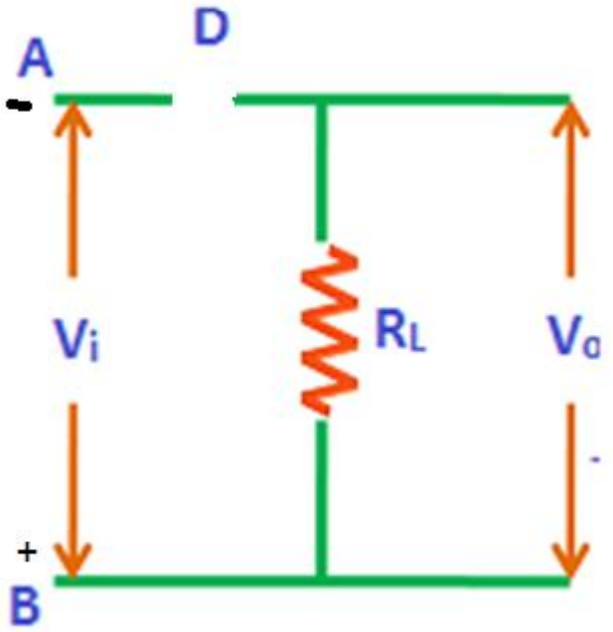
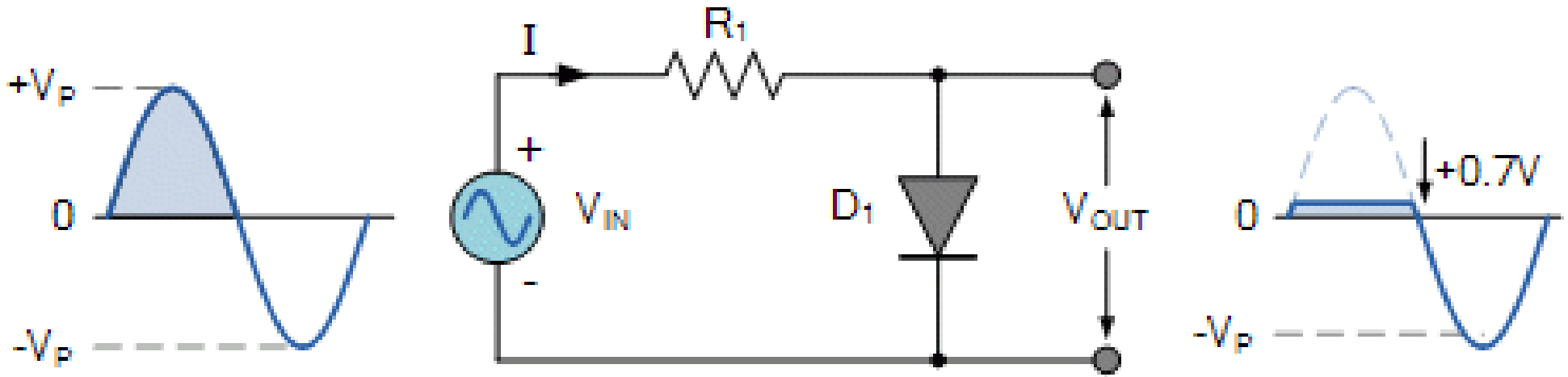




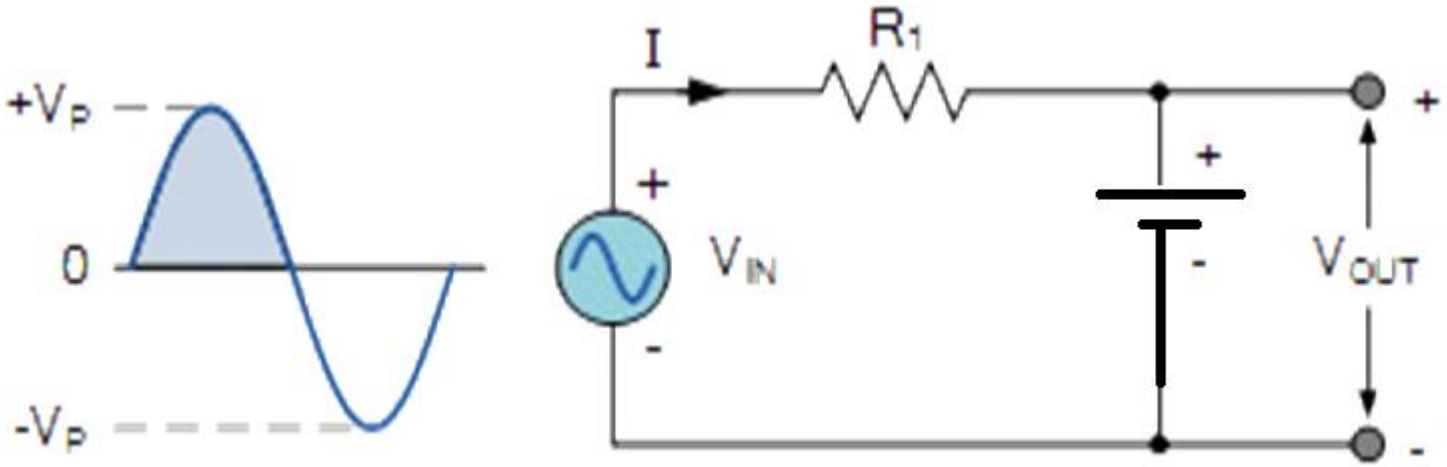
Negative Half Cycle

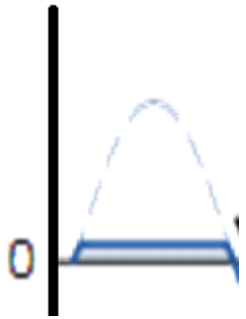


Parallel Clipper

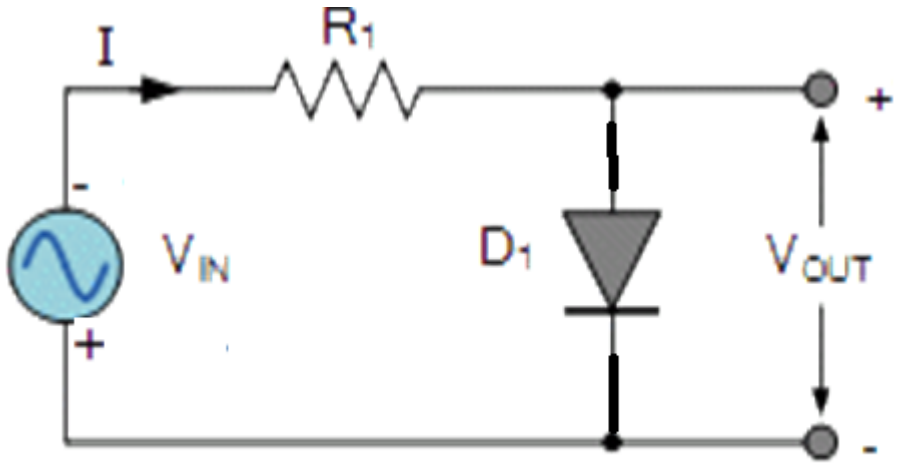


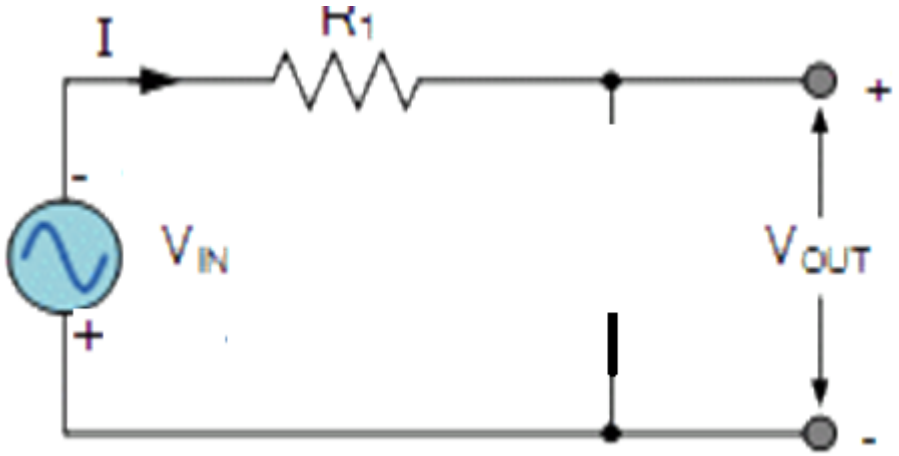
Positive Half Cycle



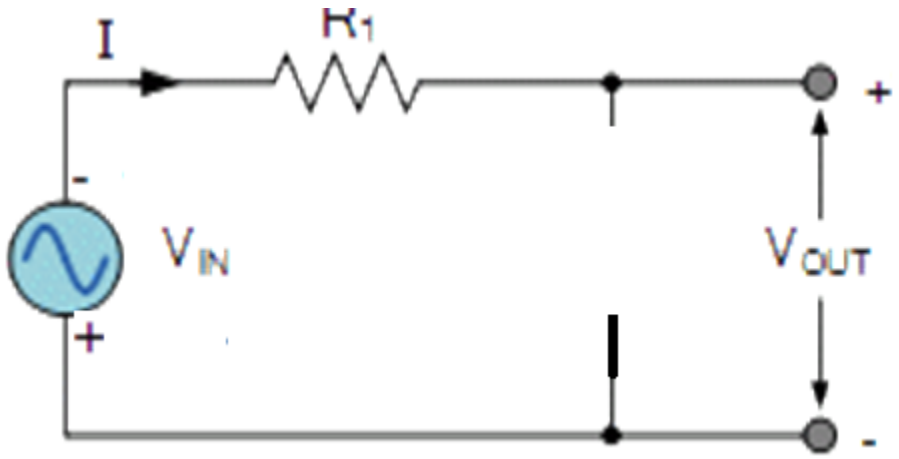


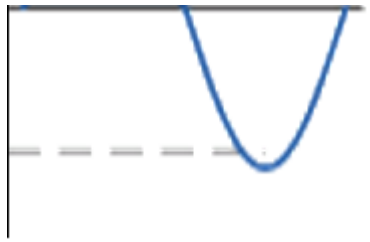
Negative Half Cycle



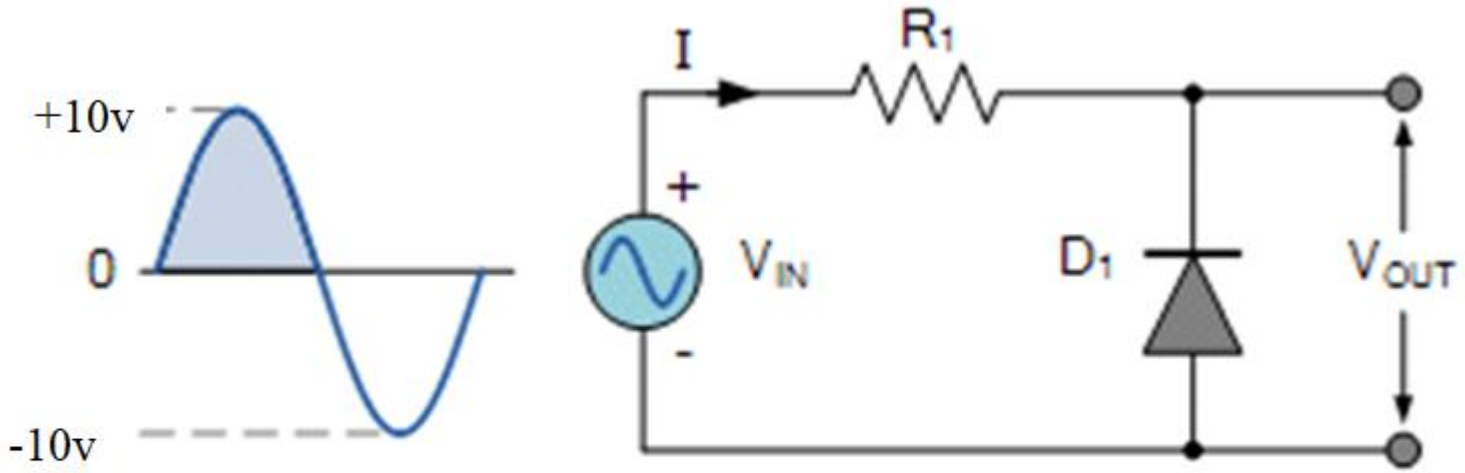


Contd..





Example



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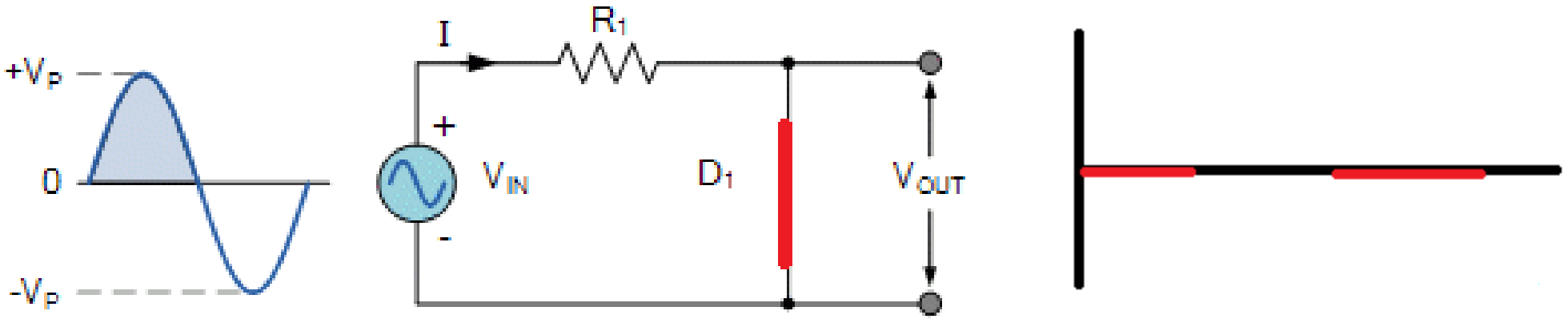

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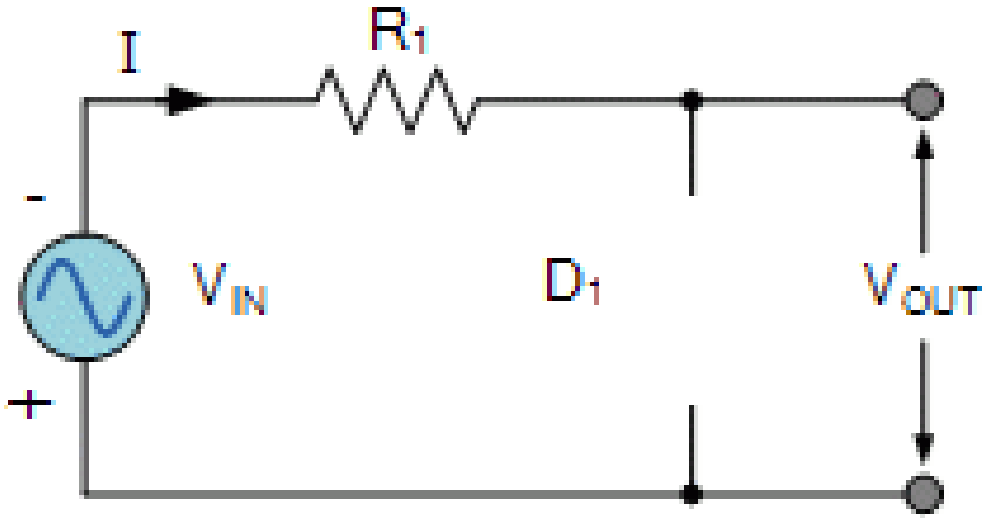
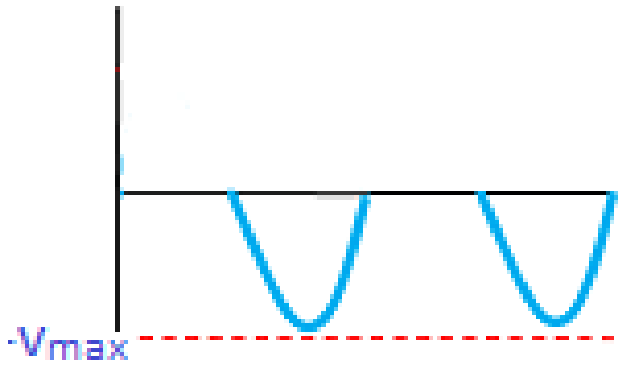
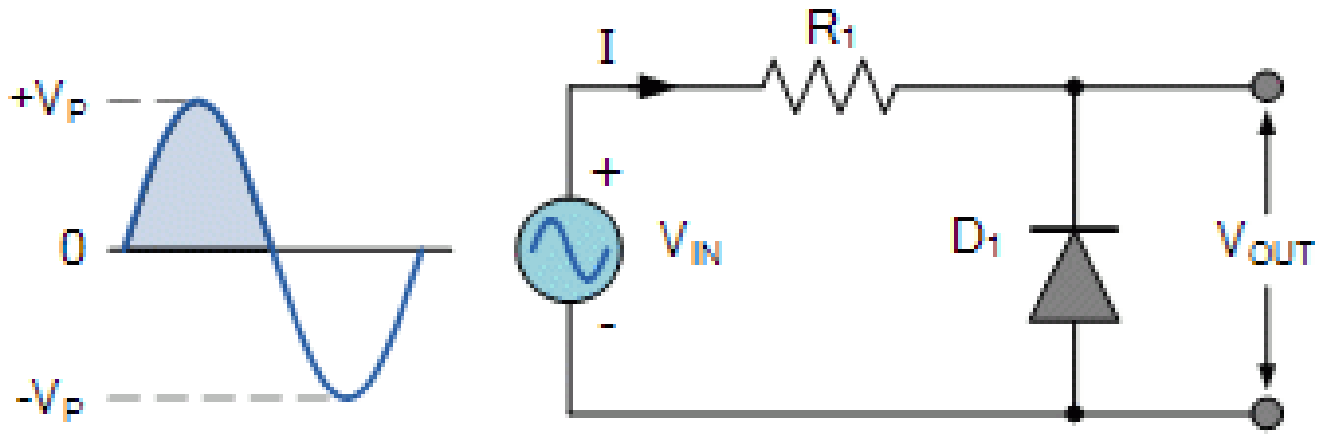
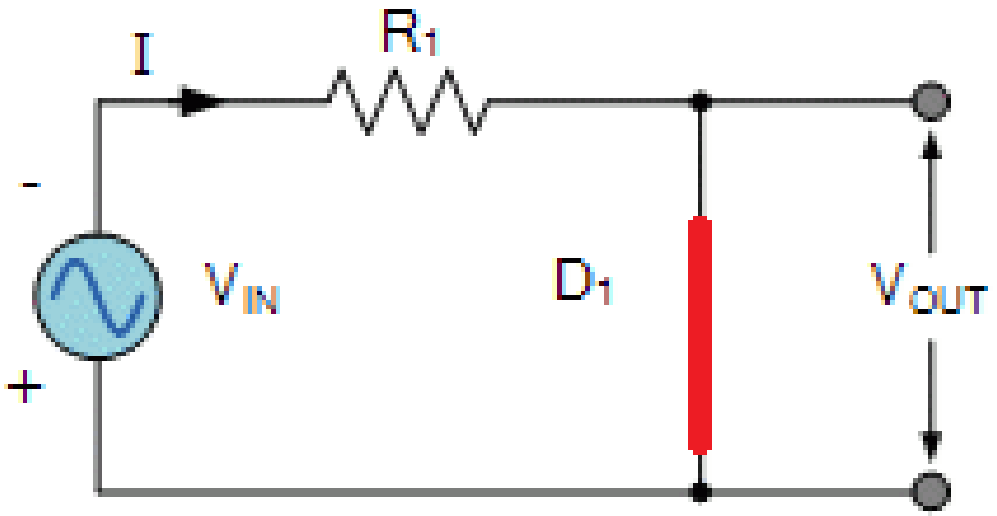




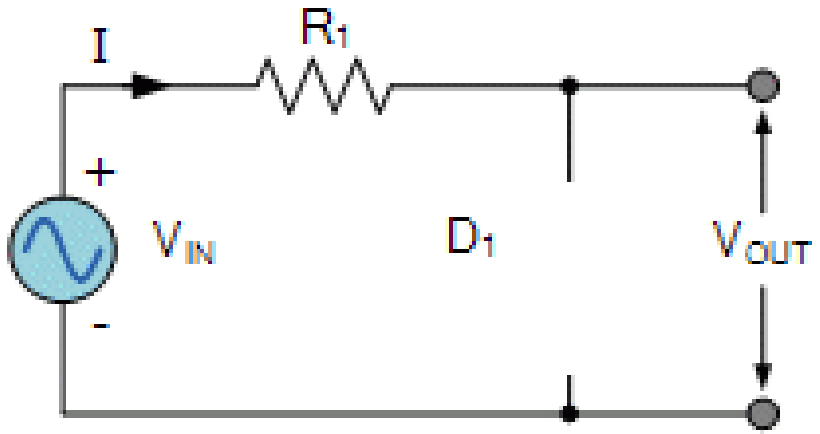
Example (ideal diode)

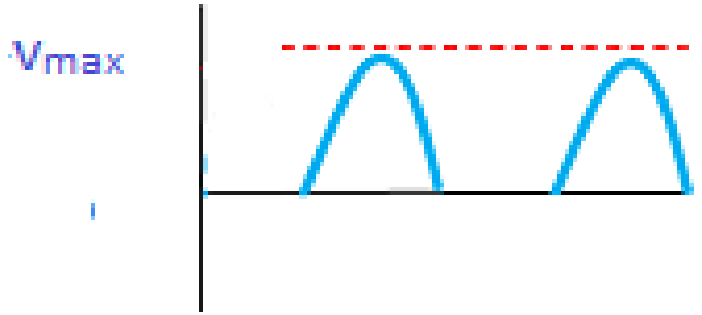


Negative Half Cycle

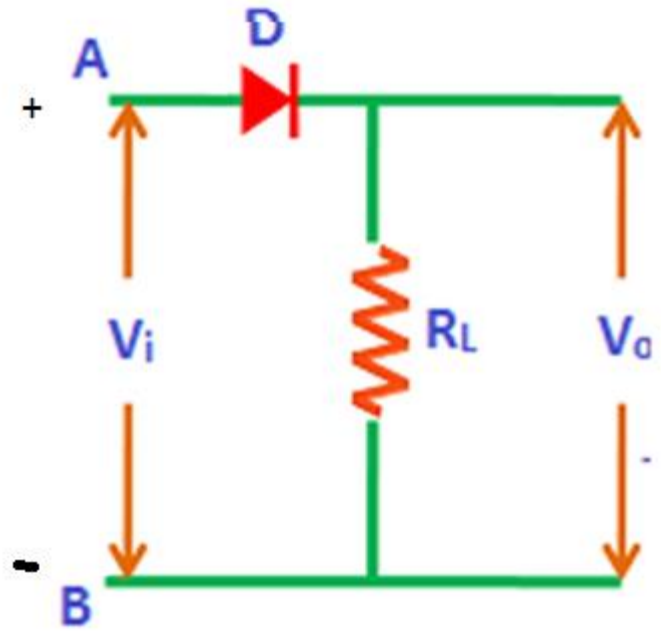


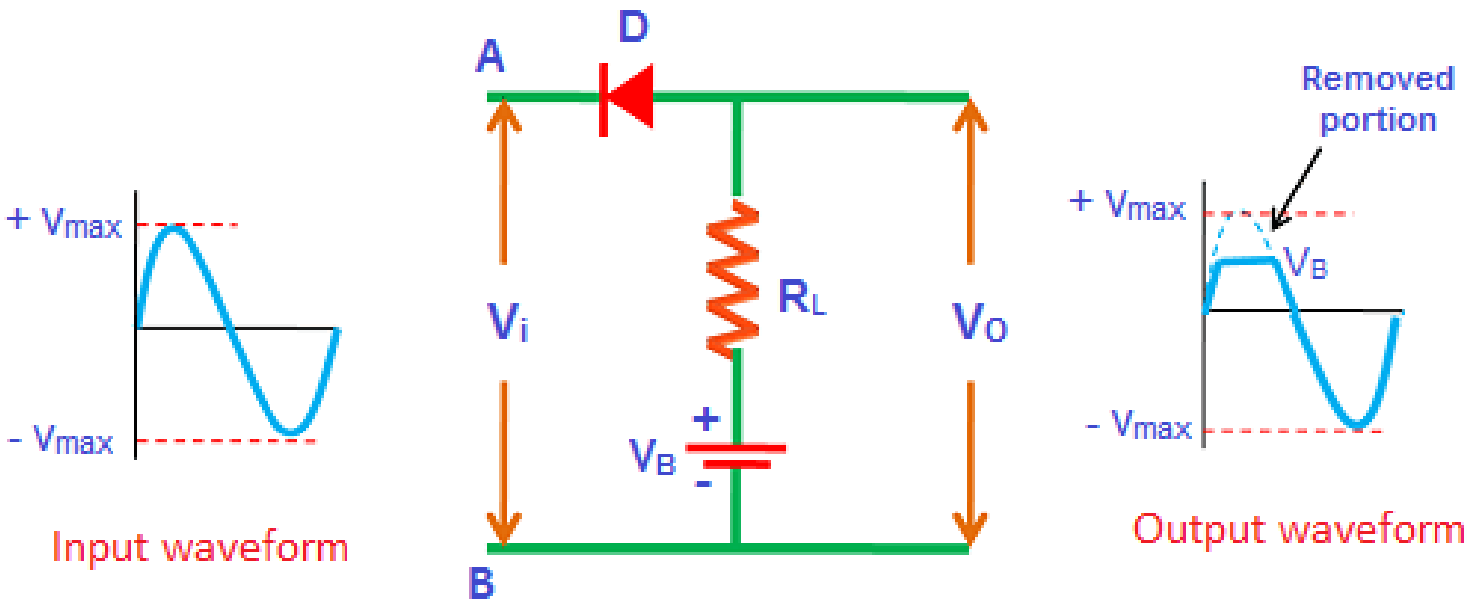
Positive half cycle





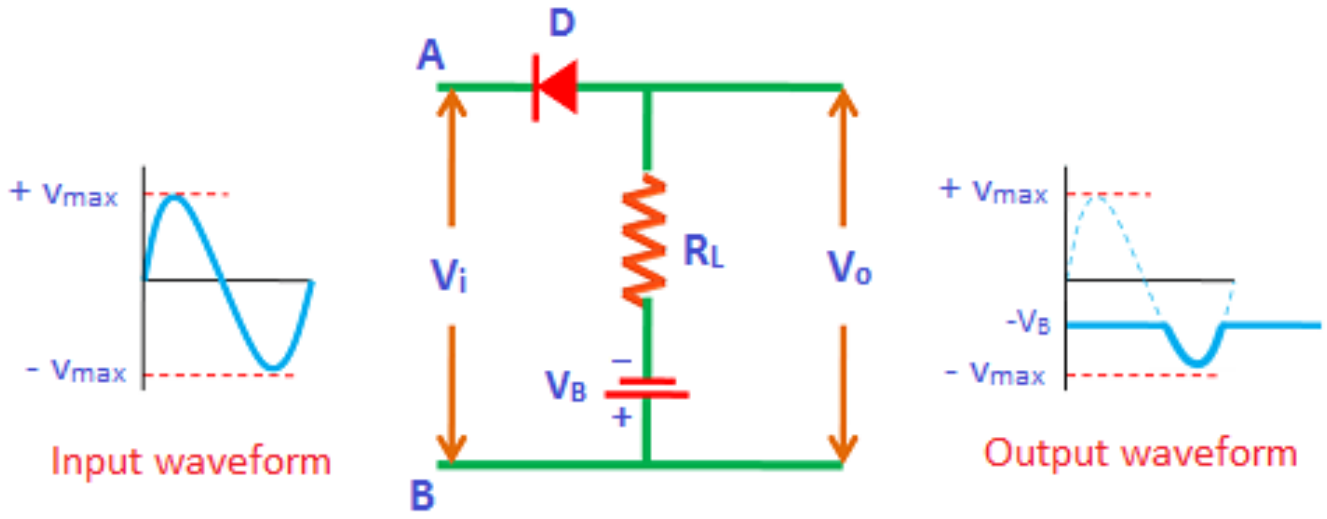
Positive Half Cycle





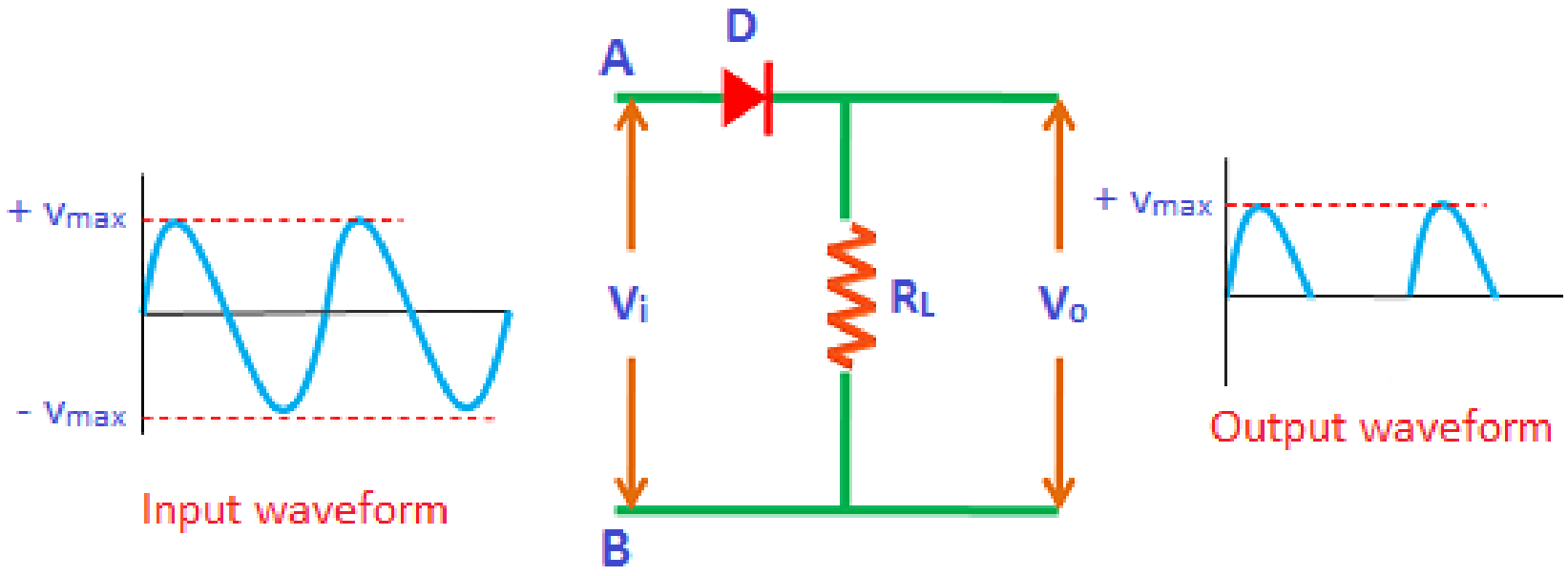
Series positive clipper with positive bias

Physics and Radio-Electronics



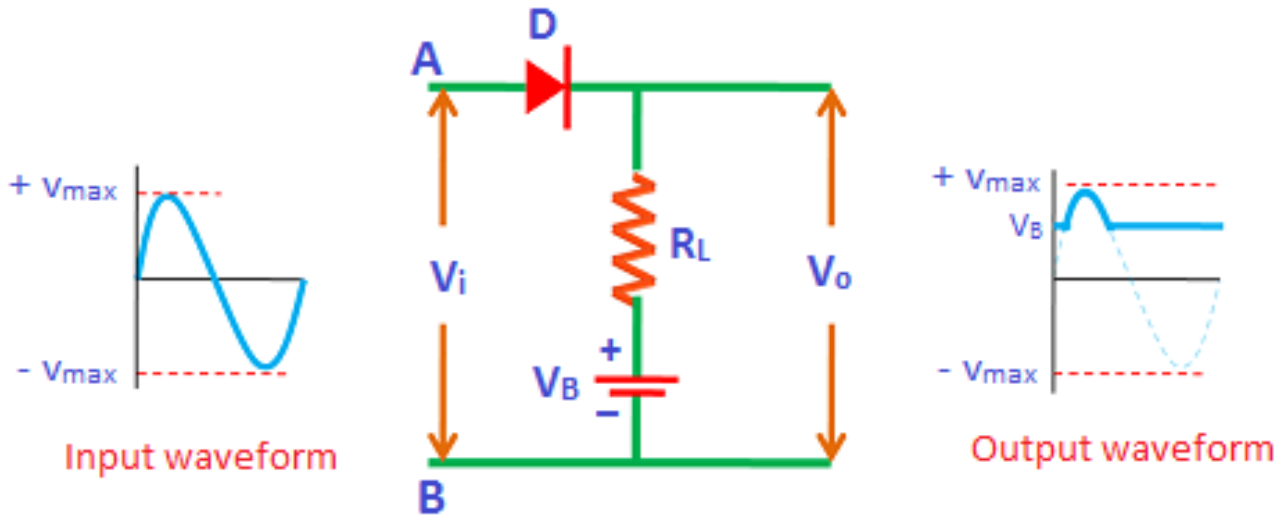
Series positive clipper with negative bias

Physics and Radio-Electronics



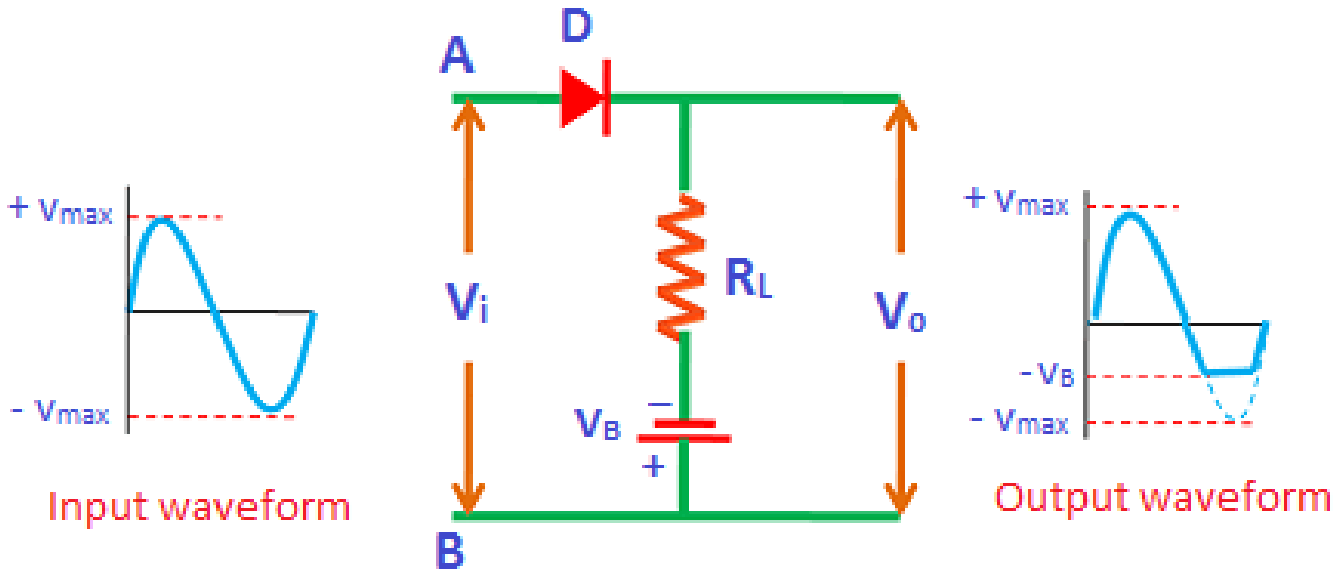
Series negative clipper

Physics and Radio-Electronics



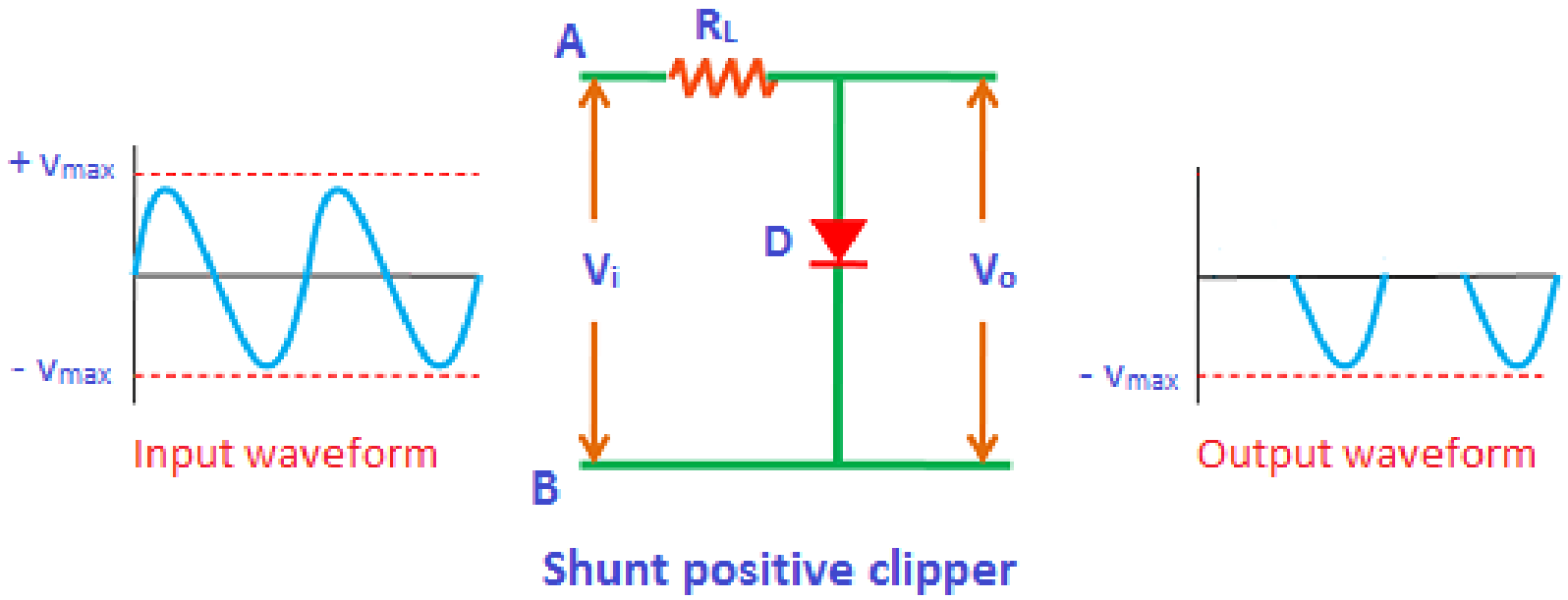
Series negative clipper with positive bias

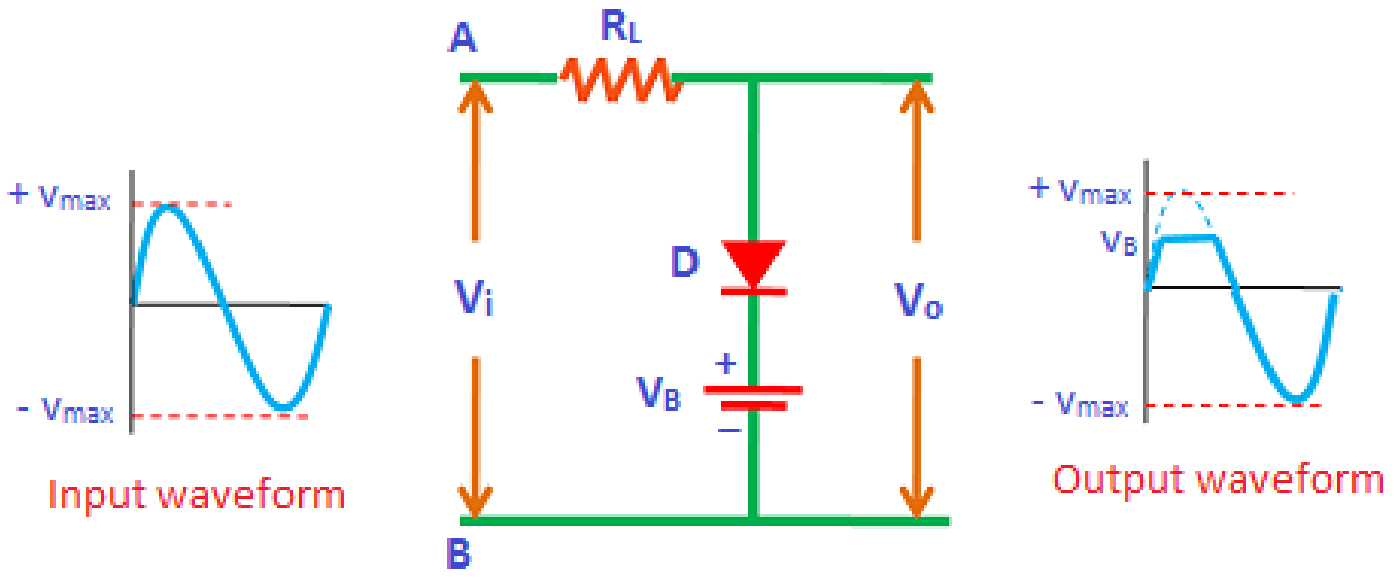
Physics and Radio-Electronics



Series negative clipper with negative bias

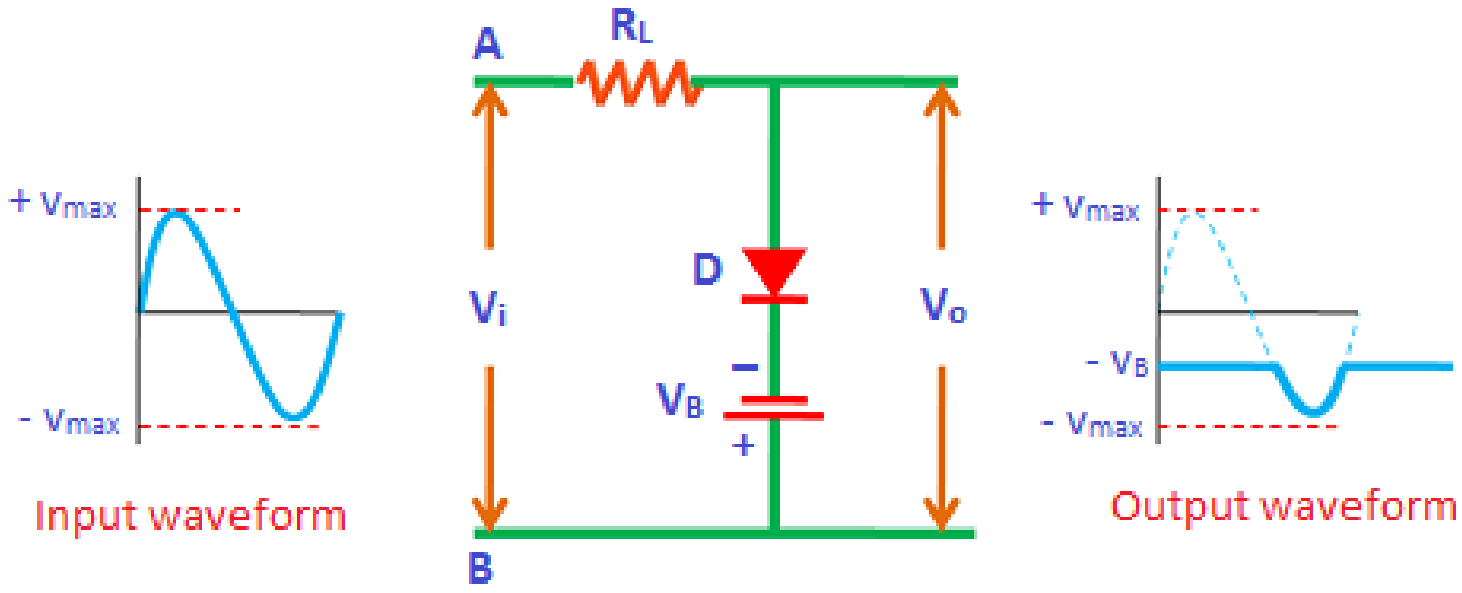
Physics and Radio-Electronics


+ Vmax
- Vmax
Input waveform
A
RL
Vi
D
Vo
B
- Vmax
Output waveform
Shunt positive clipper
Physics and Radio-Electronics



Shunt positive clipper with positive bias

Physics and Radio-Electronics



Shunt positive clipper with negative bias

Physics and Radio-Electronics