UNIT-1

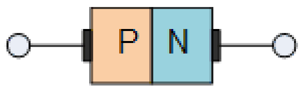
Semiconductor Diodes and Applications

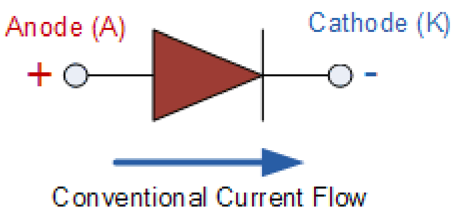
Topics

- p-n junction diode
- Diode Equivalent circuit
- Rectifiers: Half wave rectifier, Full wave rectifier, Bridge rectifier
- Rectifiers with capacitor and choke filter
- Zener diode and Zener diode as a voltage regulator
- 78XX based Fixed IC voltage regulator.

p-n junction diode

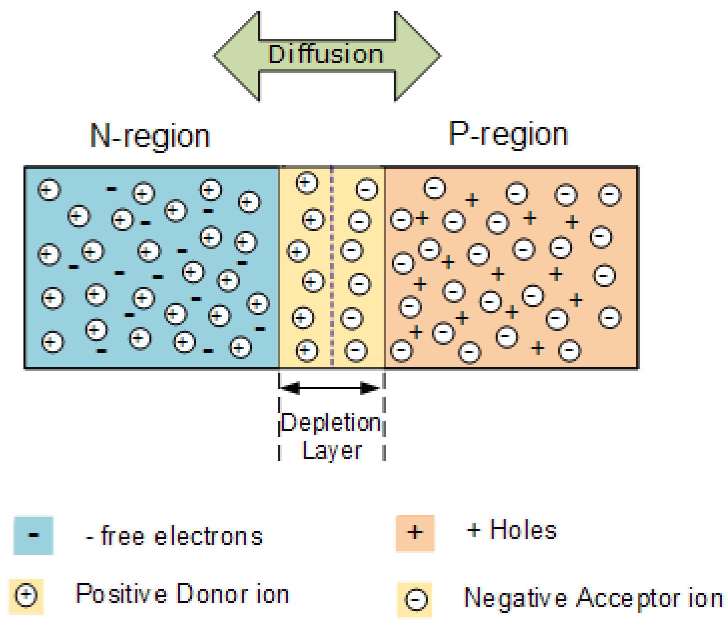
- Formed when N-type material is fused together with a P-type
- It is a two terminal device.
- Circuit Symbol of the diode





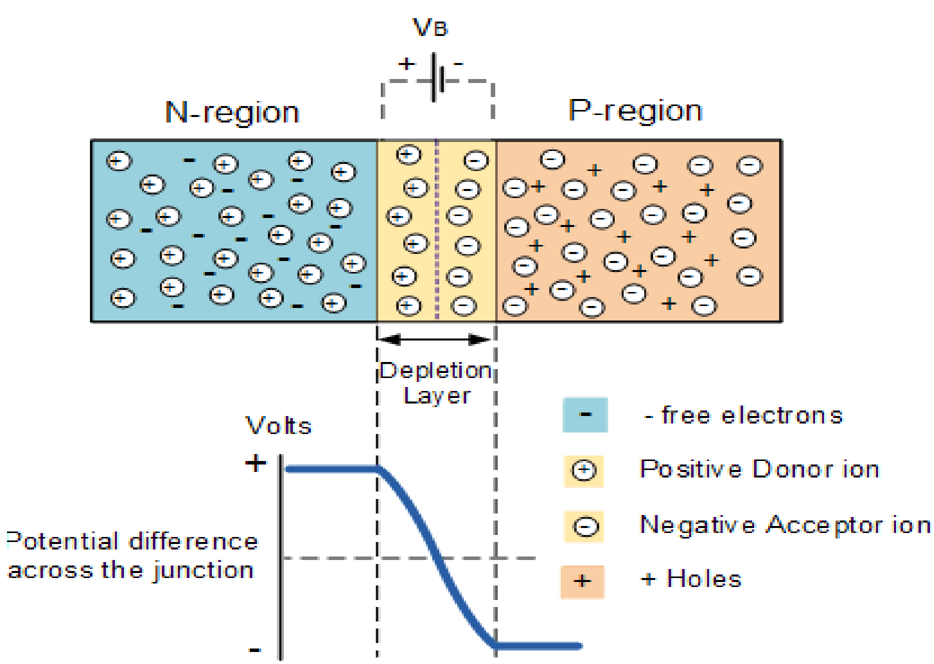
Depletion Layer

- When the N-type semiconductor and P-type semiconductor materials are joined together a very large density, gradient exists between both sides.
- The result is that some of the free electrons from the N-side begin to move across this newly formed junction to recombine with holes in the P-side.
- Similarly holes from the P-side begin to move across the junction to recombine with electrons in the N-side.



Barrier voltage of pn junction

- When the electrons move across the PN junction from the N-type silicon to the P-type silicon, they leave behind positively charged donor ions (N_D)
- When the holes move from the P-type silicon to the N-type silicon, they leave behind negatively charged acceptor ions (N_A)
- The potential difference existing near the junction due to donor charge density N_D and acceptor charge density N_A give rise to barrier voltage V_B .
- V_B is 0.7 V for Si diode and 0.3 V for Ge diode

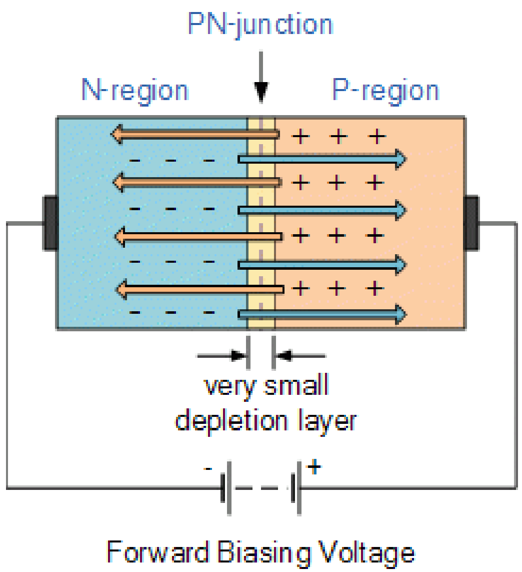


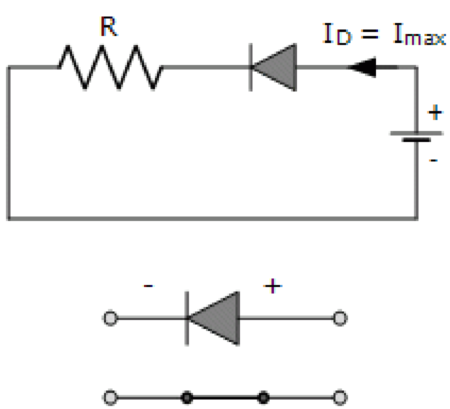
Diode Biasing

Types: Forward Bias and Reverse Bias

Forward bias

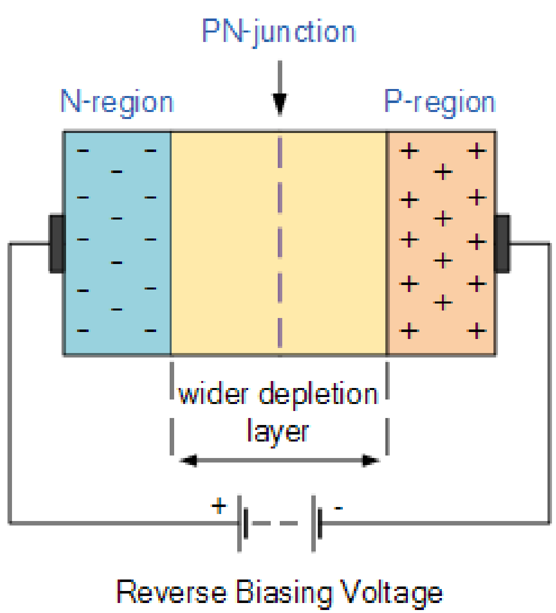
- Positive terminal is connected to the P-type and negative to the N-type material of the diode
- Depletion region width decreases, hence barrier height reduces.
- When applied forward bias voltage is greater than barrier voltage, diode conducts

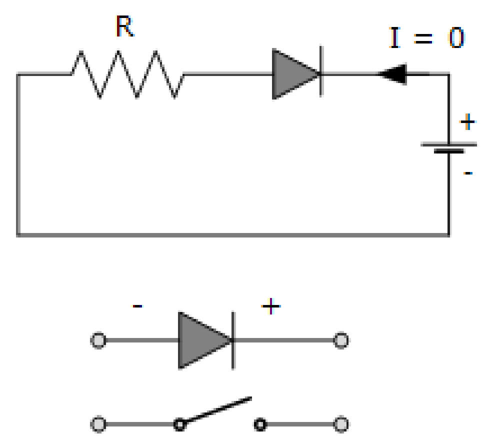




Reverse bias

- Negative terminal is connected to the P-type and positive to the N-type material of the diode
- Depletion region width increases, hence barrier height increases and diode is not conducting current.
- A very small leakage current flows through the junction due to the minority carriers , the reverse saturation current, in µA for Ge and nA for Si.

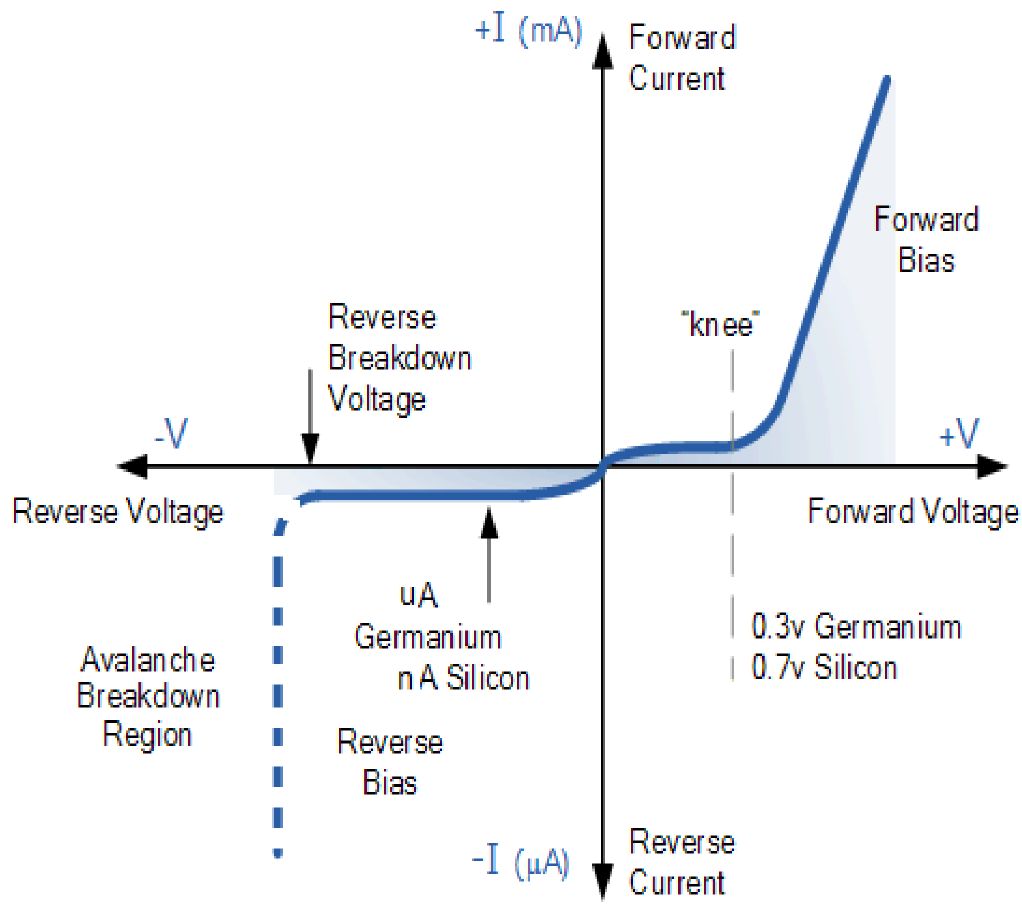




Static V-I Characteristics

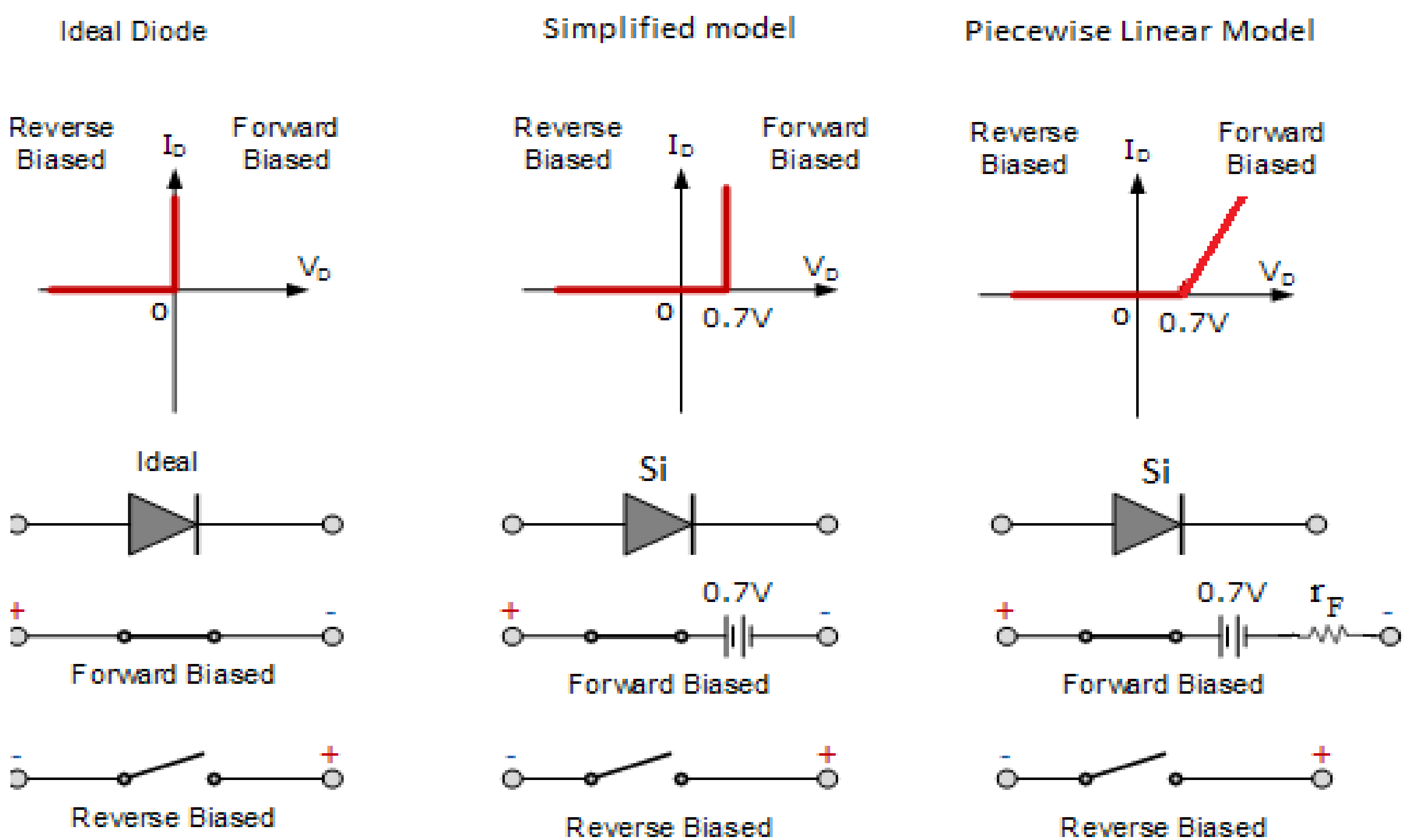
Some of the parameters of PN diode are

- Maximum Forward Current
- Forward Voltage Drop/ Knee Voltage
- Reverse breakdown voltage
- Reverse saturation current
- Dynamic resistance



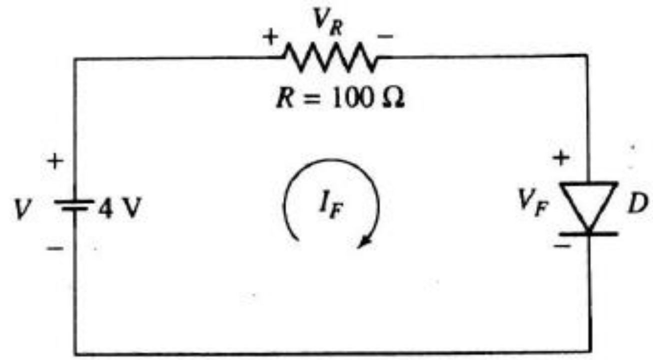
Diode Equivalent circuits

- Diode is two terminal non-linear device whose V-I characteristics are dependent on the polarity of the applied voltage.
- To analyze the circuits with diodes, diode models or diode equivalent circuits are used.



DC load line analysis

A DC load line is a straight line drawn on the diode forward characteristics that describes all the dc conditions that exist in the operation of the circuit.



Here I_F is the current through the diode and V_F is the voltage across the diode.
Applying KVL to the circuit we get,

$$-V + V_R + V_F = 0$$

$$\text{or} \quad V = I_F R + V_F$$

For $I_F = 0$, $V_F = V$. Hence when $I_F = 0$, $V_F = V$ is one of the points on load line at point A.

$$V_F = 4V,\ I_F = 0\,\text{mA}$$

when $V_F = 0$, $I_F = \frac{V}{R}$.

$V_F = 0, I_F = \frac{V}{R}$ is the second point on the DC load line at point B.

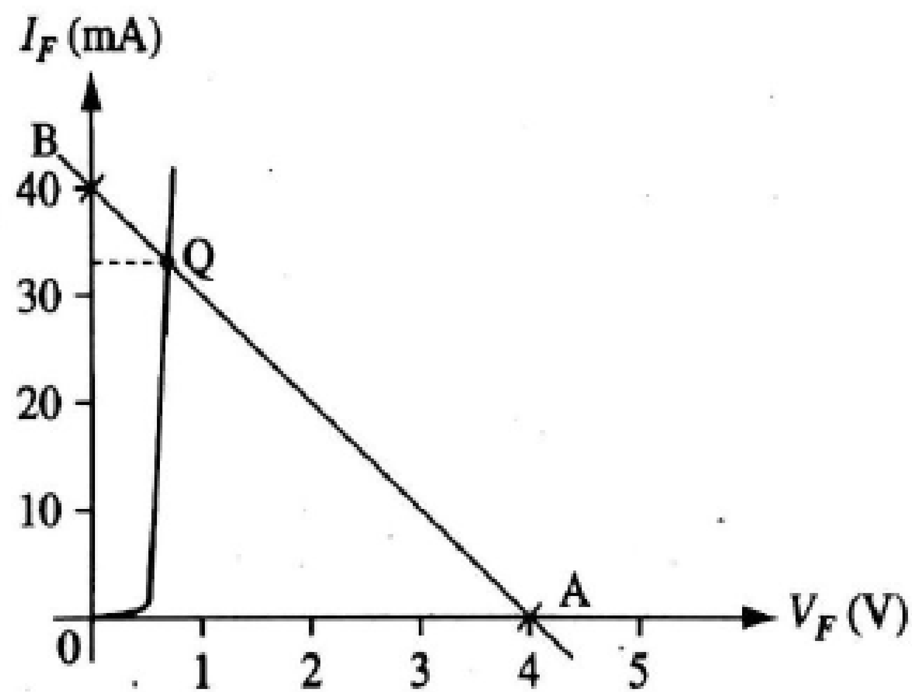
$V_F = 0, I_F = \frac{4}{100} = 40\ mA$. Join the points A and B to get the DC load line. We can see that the DC load line intersects the diode characteristics at a point Q which corresponds to and . This can be shown by applying KVL to the circuit as or

$$I_F = \frac{V - V_F}{R}$$

$$V_F = 0.7\ V \text{ for Silicon diode}$$

$$\therefore\ I_F = \frac{4 - 0.7}{100} = 33\ \text{mA}$$

The DC load line is drawn on the diode forward characteristics as shown

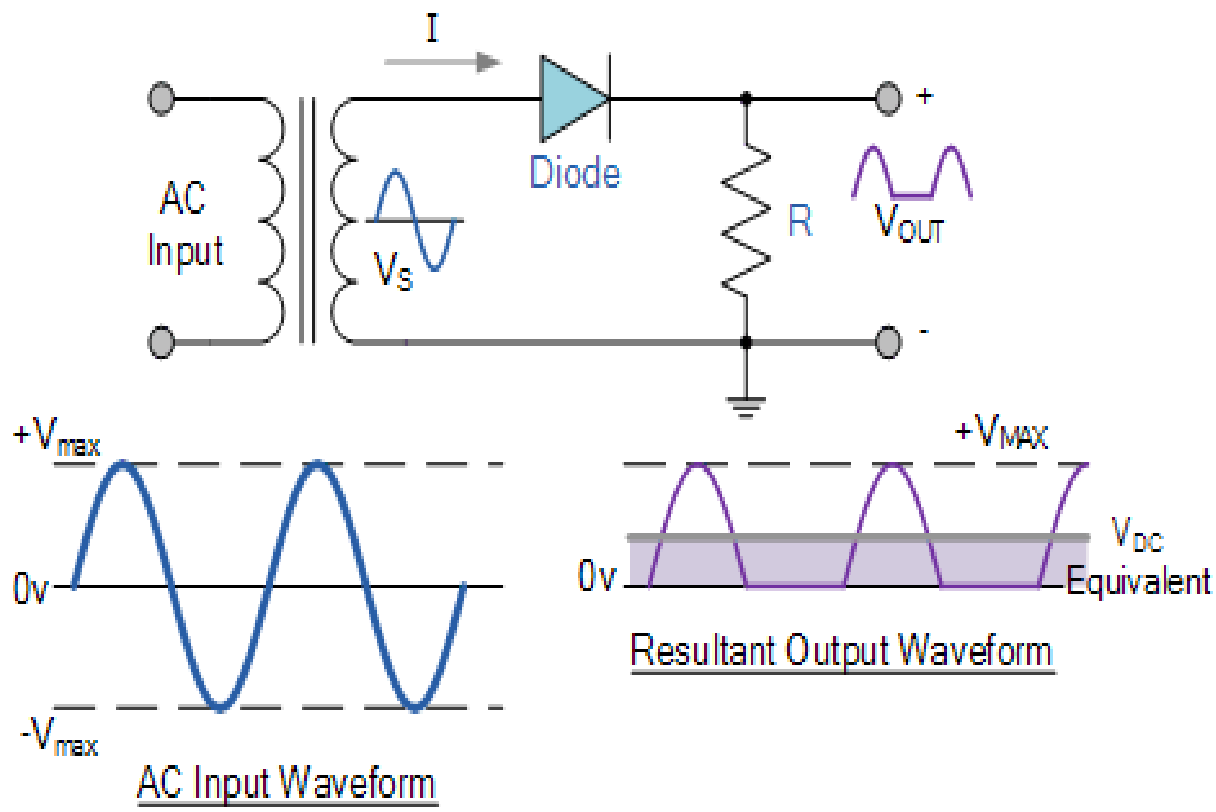


Diode Rectifiers

A rectifier is a circuit which converts the *Alternating Current* (AC) input power into a *Direct Current* (DC) output power. The input power supply may be either a single-phase or a multi-phase supply.

Half wave rectifier

Only one half cycle of input is converted to DC.



Half wave Rectifier parameters

Derivation of V_{DC}

DC Average current I_{DC}

$$I_{DC} = \frac{Area\ under\ curve\ over\ full\ cycle}{Time\ period} = \frac{1}{2\pi}\int_0^{2\pi} I_m sin\omega t d\omega t$$

$$I_{DC} = \frac{1}{2\pi}\left[\int_0^{\pi} I_m sin\omega t d\omega t + \int_{\pi}^{2\pi} I_m sin\omega t d\omega t\right]$$

$$I_{DC} = \frac{1}{2\pi}\left[\int_0^{\pi} I_m sin\omega t d\omega t + \int_{\pi}^{2\pi} 0 d\omega t\right] \text{ since } I_L=0, \pi \le \omega t \le 2\pi$$

$$I_{DC} = \frac{1}{2\pi}\left[\int_0^{\pi} I_m sin\omega t d\omega t\right]$$

$$I_{DC} = \frac{I_m}{2\pi}[-cos\omega t]_0^{\pi} = \frac{-I_m}{2\pi}[-1-1] = \frac{I_m}{\pi}$$

DC Average Voltage V_{DC}

$$V_{DC} = I_{DC} R_L = \frac{I_m}{\pi} R_L$$

Where , $I_m = \frac{V_m}{R_f + R_S + R_L}$ $\therefore V_{DC} = \frac{V_m}{R_f + R_S + R_L} \frac{R_L}{\pi} = \frac{V_m}{\pi} \frac{R_L}{R_f + R_S + R_L}$

When the load resistor $R_L >> R_f$ *and* R_s ,

The dc value of the output voltage is $V_{dc} = \frac{V_m}{\pi}$

Derivation of V_{rms}

Root mean square load current, $\boldsymbol{I_{rms}}$

$$I_{rms} = \sqrt{\frac{1}{2\pi}\int_0^{2\pi} {I_L}^2\, d\omega t} \quad = \sqrt{\frac{1}{2\pi}\int_0^{2\pi} {I_m}^2 sin^2\omega t d\omega t}$$

$$I_{rms} = \sqrt{\frac{1}{2\pi}[\int_0^{\pi} {I_m}^2 sin^2\omega t d\omega t + \int_{\pi}^{2\pi} {I_m}^2 sin^2\omega t d\omega t]}$$

$$= \sqrt{\frac{1}{2\pi}\int_0^{\pi} {I_m}^2 sin^2\, \omega t\ \ d\omega t} \qquad \text{since } I_L=0,\ \pi \le \omega t \le 2\pi$$

$$= \sqrt{\frac{{I_m}^2}{2\pi}\int_0^{\pi} \frac{1-cos\,2\omega t}{2} d\omega t} = \sqrt{\frac{{I_m}^2}{2\pi}[\frac{1}{2}\int_0^{\pi} d\omega t - \frac{1}{2}\int_0^{\pi} cos2\omega t d\omega t]}$$

$$= \sqrt{\frac{{I_m}^2}{2\pi}[\frac{1}{2}[\omega t]_0^{\pi} - \frac{1}{2}[\frac{sin\,2\omega t}{2}]_0^{\pi} d\omega t]}$$

$$= \sqrt{\frac{{I_m}^2}{2\pi}[\frac{\pi}{2} - 0]} = \boldsymbol{\frac{I_m}{2}}$$

Root mean square load voltage, V_{rms}

$$V_{rms} = I_{rms} R_L = \frac{I_m}{2} R_L$$

Where , $I_m = \frac{V_m}{R_f + R_S + R_L}$

$$\therefore \; V_{rms} = \frac{V_m}{R_f + R_S + R_L} \frac{R_L}{2} = \frac{V_m}{2} \frac{R_L}{R_f + R_S + R_L}$$

When the load resistor $R_L >> R_f \; and \; R_s$,

The rms value of the output voltage is $V_{rms} = \frac{V_m}{2}$

Derivation of Ripple factor

The ripple factor is the measure of conversion from AC to DC of the rectifier is

$$r = \frac{rms\ value\ of\ ac\ component\ of\ the\ output}{dC\ value\ of\ the\ output} = \frac{I_{ac}}{I_{dc}} \quad \text{----(1)}$$

Where $I_{ac}^2 = I_{rms}^2 - I_{dc}^2$

Substituting in (1),

$$r = \frac{I_{ac}}{I_{dc}} = \frac{\sqrt{I_{rms}^2 - I_{dc}^2}}{I_{dc}} = \sqrt{\left(\frac{I_{rms}}{I_{dc}}\right)^2 - 1}$$

Substitute, $I_{rms} = \frac{I_m}{2}$ & $I_{dc} = \frac{I_m}{\pi}$

We get, $r = \sqrt{\left(\frac{\frac{I_m}{2}}{\frac{I_m}{\pi}}\right)^2 - 1} = \mathbf{1.21}$

Derivation of Rectification Efficiency

The efficiency of the rectifier is

$$\eta = \frac{dc\ power\ delivered\ to\ the\ load}{ac\ input\ power\ from\ the\ transformer\ secondary} = \frac{P_{dc}}{P_{ac}}$$

DC output power $P_{dc} = \boldsymbol{I_{dc}}^{\mathbf{2}} R_L$

AC input power $P_{ac} = \boldsymbol{I_{rms}}^{\mathbf{2}}(R_f + R_s + R_L)$

$$\eta = \frac{\boldsymbol{I_{dc}}^{\mathbf{2}} R_L}{\boldsymbol{I_{rms}}^{\mathbf{2}}(R_f + R_s + R_L)}$$

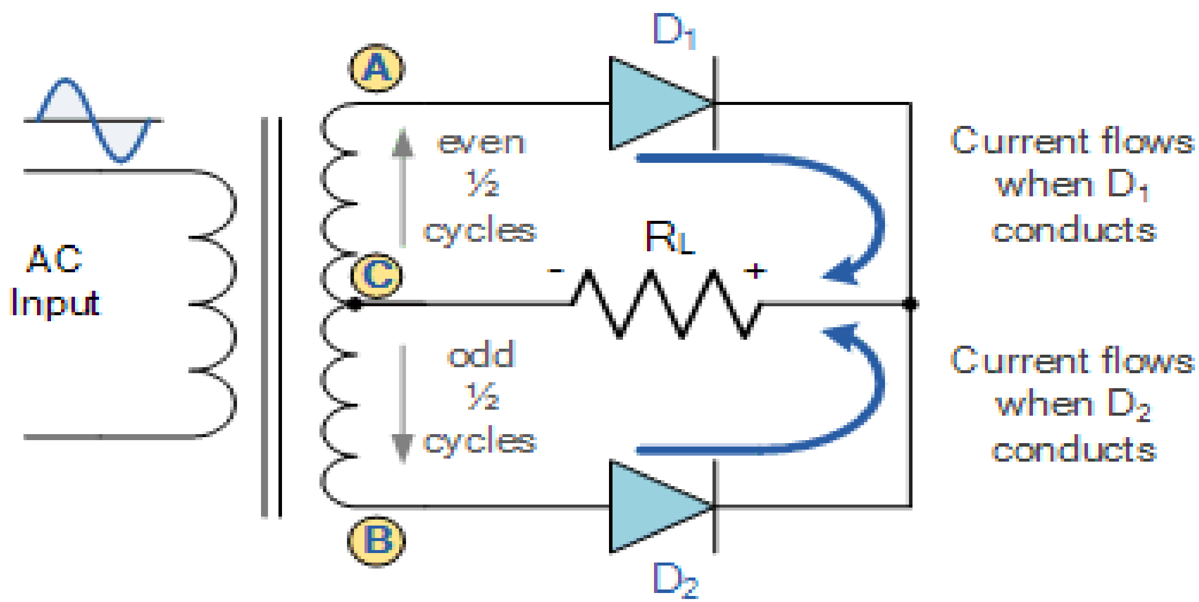
Substitute, $I_{rms} = \frac{I_m}{2}$ & $I_{dc} = \frac{I_m}{\pi}$

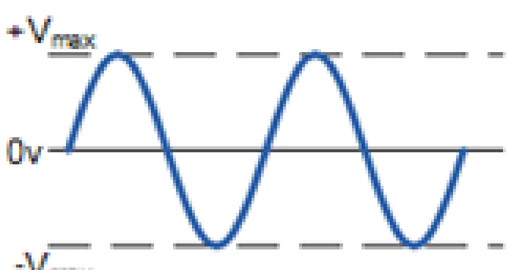
□ $\eta = \frac{(\frac{I_m}{\pi})^{\mathbf{2}} R_L}{(\frac{I_m}{2})^{\mathbf{2}}(R_f + R_s + R_L)}$

If $R_L >> R_f$, the efficiency $\eta = 40.6\ \%$

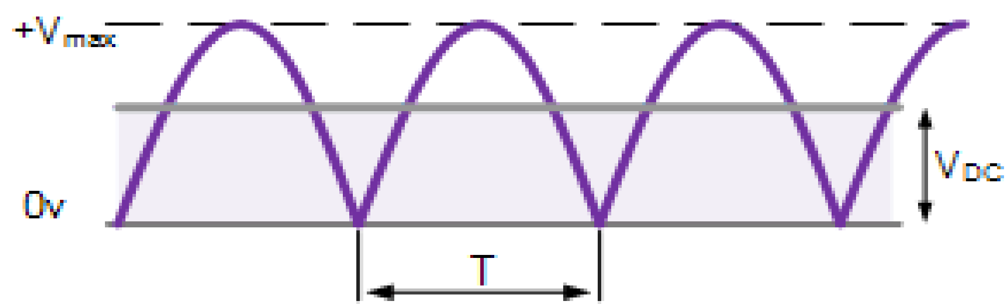
Full wave rectifier

Center tapped Transformer full wave rectifier



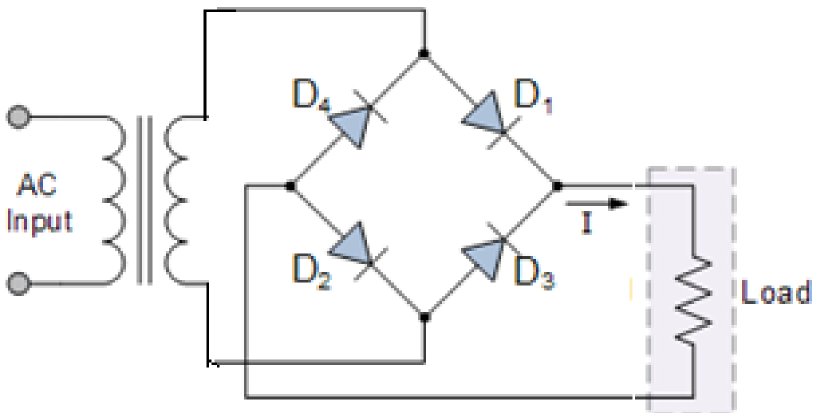


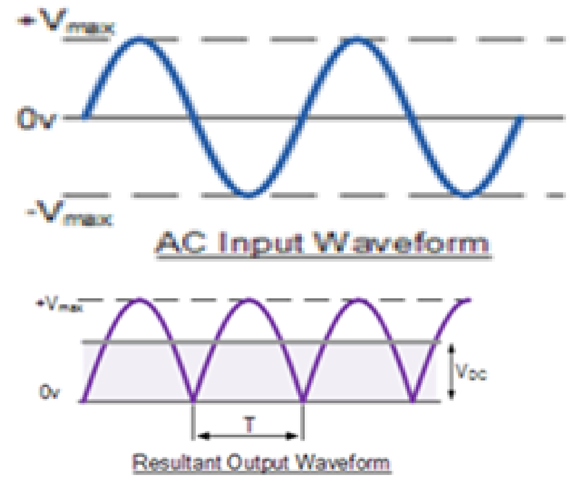
AC Input Waveform

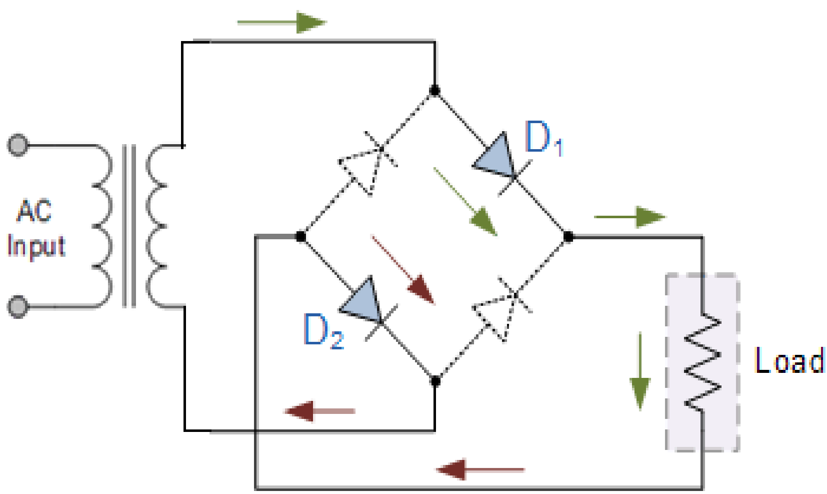


Resultant Output Waveform

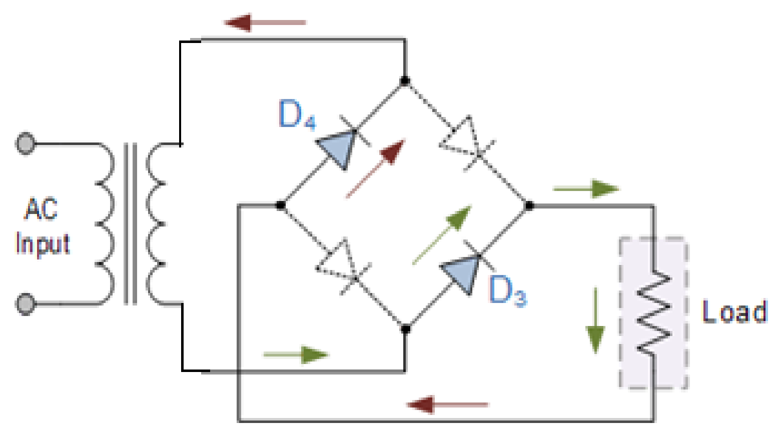
Bridge Rectifier







Equivalent circuit for Positive half cycle input



Equivalent circuit for negative half cycle input

Full wave Rectifier parameters

Derivation of V_{DC}

DC Average current $\boldsymbol{I_{DC}}$

$$I_{DC} = \frac{Area\ under\ curve\ over\ full\ cycle}{Time\ period} = \frac{1}{2\pi}\int_0^{2\pi} I_m sin\omega t d\omega t$$

$$I_{DC} = \frac{1}{2\pi}\left[\int_0^{\pi} I_m sin\omega t d\omega t + \int_{\pi}^{2\pi} I_m sin\omega t d\omega t\right]$$

$$I_{DC} = \frac{1}{2\pi}\left[2\int_0^{\pi} I_m sin\omega t d\omega t\right] = \frac{1}{\pi}\left[\int_0^{\pi} I_m sin\omega t d\omega t\right]$$

$$I_{DC} = \frac{I_m}{\pi}[-cos\omega t]_0^{\pi} = \frac{-I_m}{2\pi}[-1-1] = \frac{2I_m}{\pi}$$

DC Average Voltage V_{DC}

$$V_{DC} = I_{DC} R_L = \frac{2I_m}{\pi} R_L$$

Where , $I_m = \dfrac{V_m}{R_f + R_S + R_L}$

$$\therefore V_{DC} = \frac{2V_m}{R_f + R_S + R_L} \frac{R_L}{\pi} = \frac{2V_m}{\pi} \frac{R_L}{R_f + R_S + R_L}$$

When the load resistor $R_L >> R_f \; and \; R_s$,

The dc value of the output voltage is $\boldsymbol{V_{dc} = \frac{2V_m}{\pi}}$

Derivation of V_{rms}

Root mean square load current, I_{rms}

$$I_{rms} = \sqrt{\frac{1}{2\pi}\int_0^{2\pi} {I_L}^2 \, d\omega t} = \sqrt{\frac{1}{2\pi}\int_0^{2\pi} {I_m}^2 sin^2\omega t d\omega t}$$

$$I_{rms} = \sqrt{\frac{1}{2\pi}[\int_0^{\pi} {I_m}^2 sin^2\omega t d\omega t + \int_{\pi}^{2\pi} {I_m}^2 sin^2\omega t d\omega t]}$$

$$= \sqrt{\frac{1}{2\pi} 2 \int_0^{\pi} {I_m}^2 sin^2 \, \omega t \;\; d\omega t}$$

$$= \sqrt{\frac{{I_m}^2}{\pi}\int_0^{\pi} \frac{1-cos\,2\omega t}{2} d\omega t} = \sqrt{\frac{{I_m}^2}{\pi}[\frac{1}{2}\int_0^{\pi} d\omega t - \frac{1}{2}\int_0^{\pi} cos2\omega t d\omega t]}$$

$$= \sqrt{\frac{{I_m}^2}{\pi}[\frac{1}{2}[\omega t]_0^{\pi} - \frac{1}{2}[\frac{sin\,2\omega t}{2}]_0^{\pi} d\omega t]} = \sqrt{\frac{{I_m}^2}{\pi}[\frac{\pi}{2} - 0]} = \frac{\boldsymbol{I_m}}{\sqrt{\boldsymbol{2}}}$$

Root mean square load voltage, V_{rms}

$$V_{rms} = I_{rms}\, R_L = \frac{I_m}{\sqrt{2}} R_L$$

$$\text{Where ,} \quad I_m = \frac{V_m}{R_f + R_S + R_L}$$

$$\therefore\ V_{rms} = \frac{V_m}{R_f + R_S + R_L} \frac{R_L}{\sqrt{2}} = \frac{V_m}{\sqrt{2}} \frac{R_L}{R_f + R_S + R_L}$$

When the load resistor $R_L >> R_f\ and\ R_s$,

$$\boldsymbol{V_{rms} = \frac{V_m}{\sqrt{2}}}$$

Derivation of Ripple factor

The ripple factor, the measure of conversion from AC to DC of the full wave rectifier is

$$r = \frac{rms\ value\ of\ ac\ component\ of\ the\ output}{dC\ value\ of\ the\ output} = \frac{I_{ac}}{I_{dc}}$$

where $I_{ac}^2 = I_{rms}^2 - I_{dc}^2$

$$r = \frac{I_{ac}}{I_{dc}} = \frac{\sqrt{I_{rms}^2 - I_{dc}^2}}{I_{dc}} = \sqrt{\left(\frac{I_{rms}}{I_{dc}}\right)^2 - 1}$$

Substitute, $I_{rms} = \frac{I_m}{\sqrt{2}}$ & $I_{dc} = \frac{2I_m}{\pi}$

We get, $r = \sqrt{\left(\frac{\frac{I_m}{\sqrt{2}}}{\frac{2I_m}{\pi}}\right)^2 - 1}$ = **0.482**

Derivation of Rectification Efficiency

The efficiency of the full wave rectifier is

$$\%\eta = \frac{dc\ power\ delivered\ to\ the\ load}{ac\ input\ power\ from\ the\ transformer\ secondary}\ x\ 100 = \frac{P_{dc}}{P_{ac}}\ x\ 100$$

DC output power $P_{dc} = \boldsymbol{I_{dc}}^{\boldsymbol{2}} R_L$

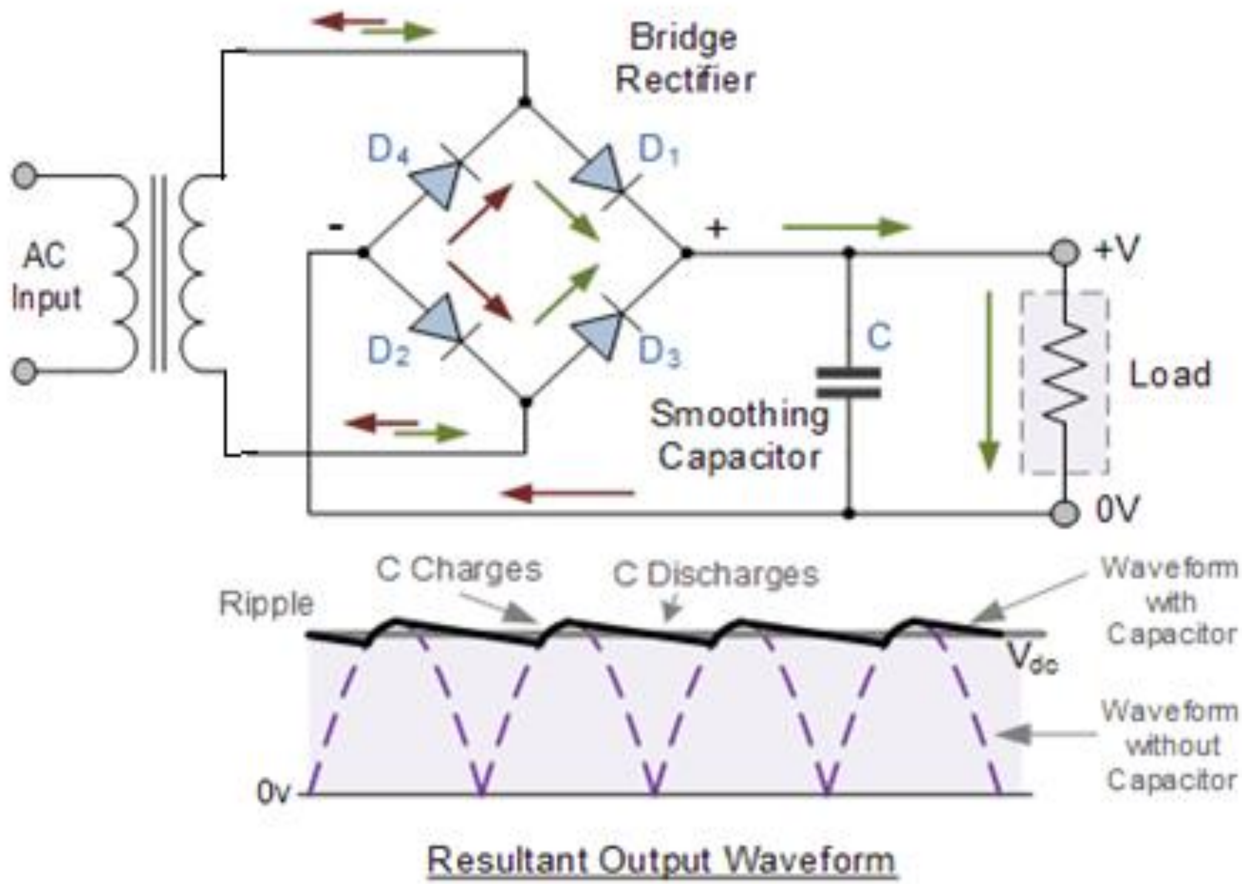
AC input power $P_{ac} = \boldsymbol{I_{rms}}^{\boldsymbol{2}} (R_f + R_s + R_L)$

$$\eta = \frac{\boldsymbol{I_{dc}}^{\boldsymbol{2}} R_L}{\boldsymbol{I_{rms}}^{\boldsymbol{2}} (R_f + R_s + R_L)}$$

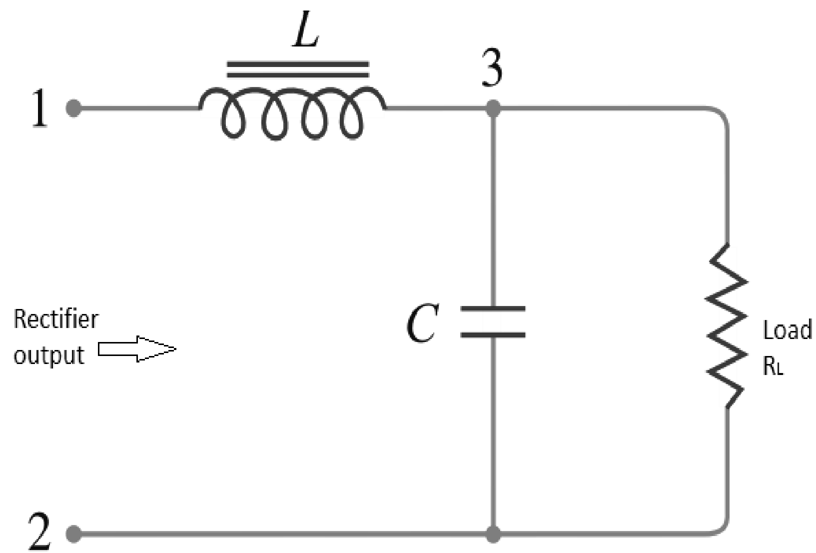
Substitute, $I_{rms} = \frac{I_m}{\sqrt{2}}$ & $I_{dc} = \frac{2I_m}{\pi}$

we get $\eta = \dfrac{(\frac{2Im}{\pi})^{\boldsymbol{2}} R_L}{(\frac{Im}{\sqrt{2}})^{\boldsymbol{2}} (R_f + R_S + R_L)}$ = 0.812 = 81.2 %

Full Wave Rectifier with Capacitor Filter



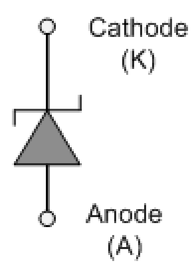
Choke Filter



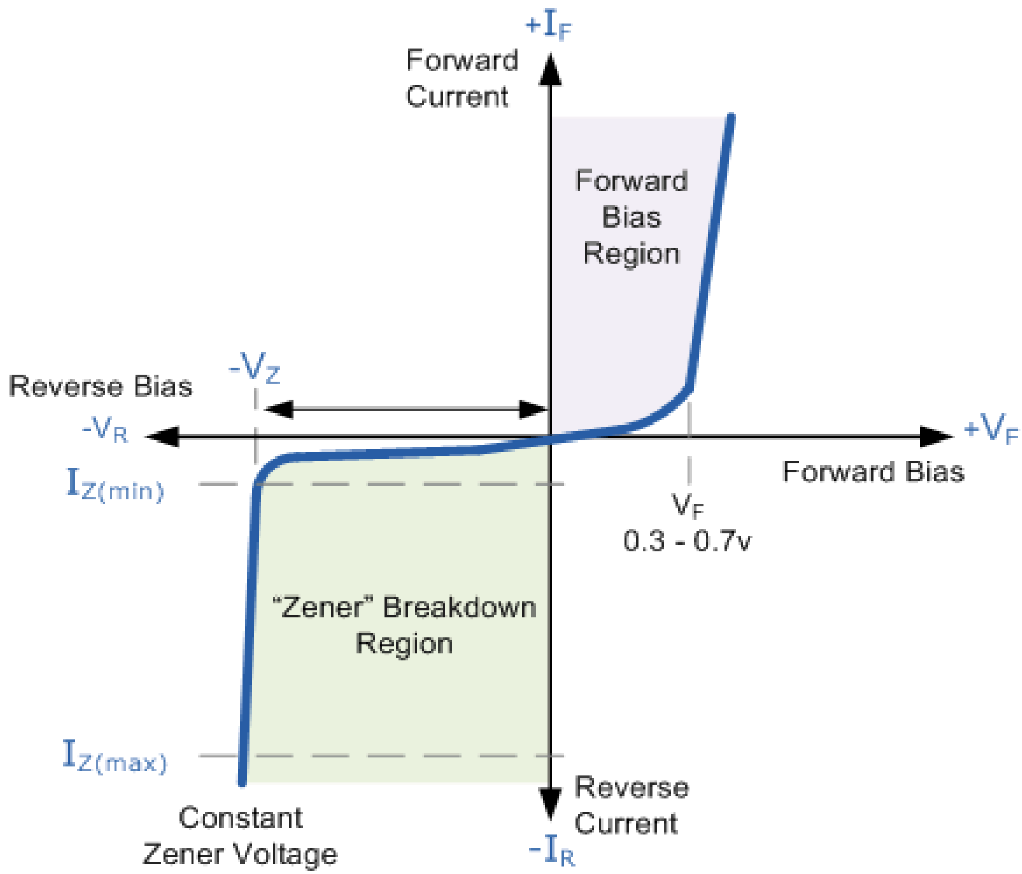
- It consists of an inductor connected in series with rectifier output circuit and a capacitor connected in parallel with the load resistor R_L as in figure.
- The inductor efficiently removes AC ripples, a small percentage of AC ripples is still present in the filtered signal.
- These ripples are then removed by the capacitor connected in parallel to the load resistor.
- Hence, the DC output signal is free from AC components, and this regulated DC can be used in any application.

Zener Diode

- Zener diode is used in reverse bias mode
- In the breakdown region zener current remains between $I_{Z(min)}$ and the maximum curent rating $I_{Z(max)}$
- In the breakdown region, voltage across the zener is constant at V_Z

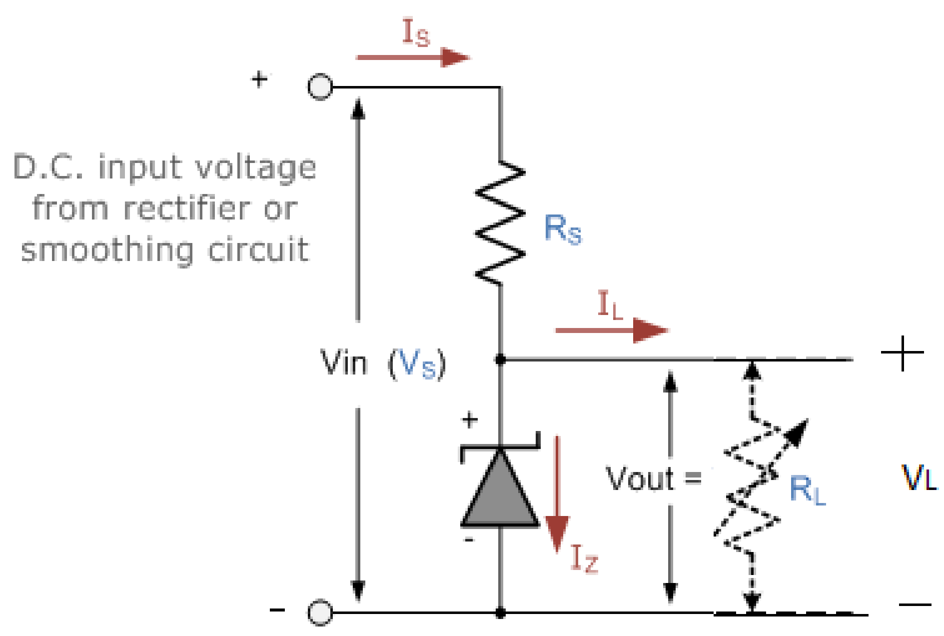


Zener Diode V-I Characteristics



Zener Diode Voltage Regulator

Zener Diode can be used to produce a stabilised voltage output with low ripple under varying load current conditions. By passing a small current through the diode from a voltage source, via a suitable current limiting resistor (R_S), the zener diode will conduct sufficient current to maintain a voltage drop of Vout.



When no load is connected (($I_L = 0$):

- With no load connected to the circuit, the load current will be zero, ($I_L = 0$), and all the circuit current passes through the zener diode which in turn dissipates its maximum power.
- The small value of the series resistor R_S will result in a greater diode current when the load resistance R_L is connected and large as this will increase the power dissipation requirement of the diode
- The value of series resistance should be selected in such a way that the zener's maximum power rating is not exceeded under this no-load or high-impedance condition.

When the load R_L is connected across the diode:

- The load is connected in parallel with the zener diode, so the voltage across R_L is always the same as the zener voltage, ($V_R = V_Z$).
- There is a minimum zener current for which the stabilization of the voltage is effective and the zener current must stay above this value operating under load within its breakdown region at all times.
- The upper limit of current is of course dependant upon the power rating of the device. The supply voltage V_S must be greater than V_Z.

Voltage regulation can be done through two techniques:

1. **Line regulation:** In this case, series resistor R_s and load resistor R_L are kept constant. It is assumed that all the variations in voltage arise due to fluctuations in input power supply. The regulated output voltage is achieved for input voltage above certain minimum level.

% regulation is given by $\frac{\Delta V_o}{\Delta V_{in}} \times 100$

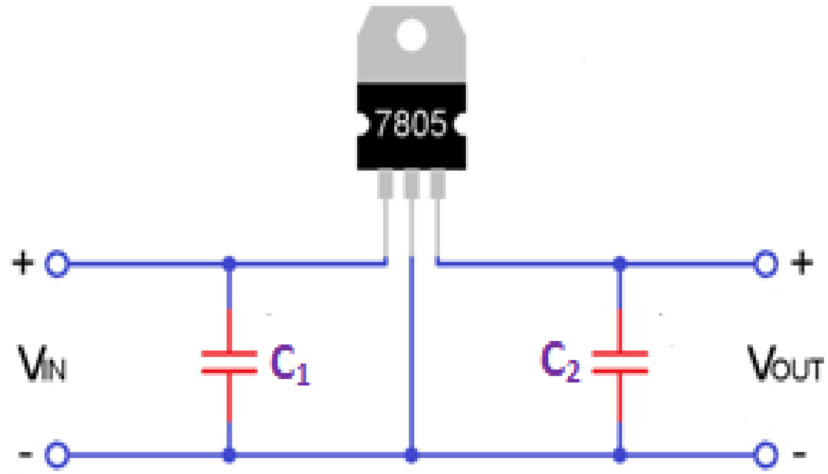
2. **Load regulation:** In this case, the input voltage is fixed, while the load resistance is varied. The constant output voltage is obtained as long as the load resistance R_L is maintained above a minimum value.

% regulation is given by $\frac{V_{NL} - V_{FL}}{V_{FL}} \times 100$

Fixed IC voltage regulator

- The integrated circuits used for the regulation of voltage are termed as voltage regulator ICs.
- The 78XX family of linear voltage regulators produce a regulated output.
- It is a fixed linear voltage regulator.
- The “xx” represent the value of the fixed output voltage that the particular IC provides.

Voltage regulator Circuit using IC 7805



Applications of IC 78xx

- Current regulator
- Regulated dual supply
- Building circuits for Phone charger, UPS power supply circuits, portable CD player etc
- Fixed output regulator
- Adjustable output regulator etc.

IC Voltage Regulators

- Regulation circuits in integrated circuit form are widely used.
- Their operation is no different but they are treated as a single device with associated components.
- These are generally three terminal devices that provide a positive or negative output.
- Some types have variable voltage outputs.
- A typical 7800 series voltage regulator is used for positive voltages.
- These voltage regulators when used with heat sinks can safely produce current values of 1A and greater.
- The capacitors act as line filtration.

IC Voltage Regulators

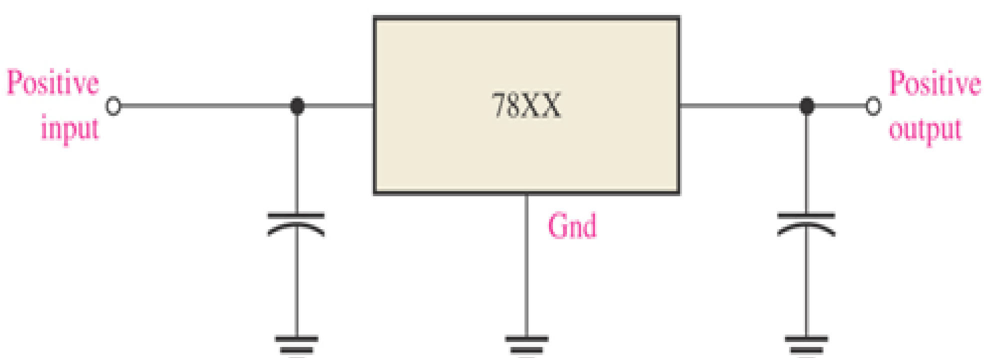
- Several types of both linear (series and shunt) and switching regulators are available in integrated circuit (IC) form.
- Single IC regulators contain the circuitry for:
  (1) reference source
  (2) comparator amplifier
  (3) control device
  (4) overload protection
- Generally, the linear regulators are three-terminal devices that provides either positive or negative output voltages that can be either fixed or adjustable.

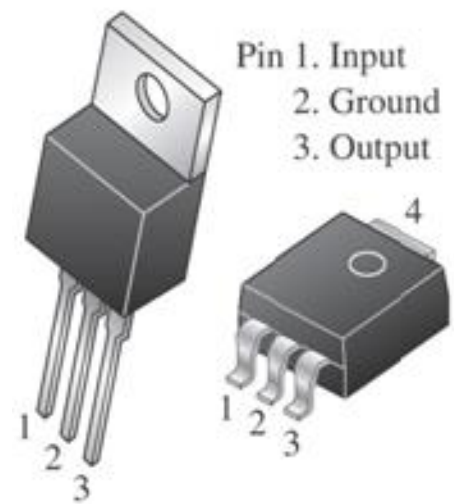
Fixed Voltage Regulator

- The fixed voltage regulator has an unregulated dc input voltage Vi applied to one input terminal, a regulated output dc voltage Vo from a second terminal, and the third terminal connected to ground.

Fixed-Positive Voltage Regulator

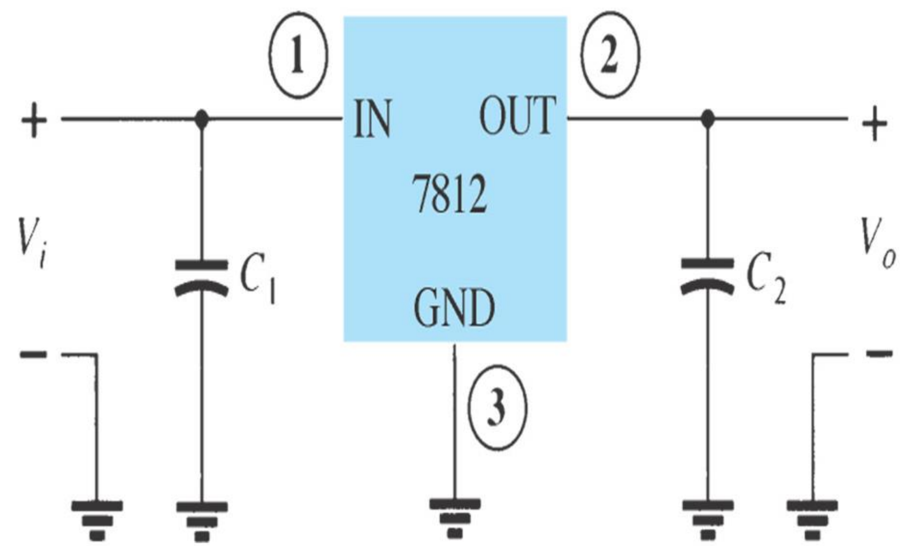
- The series 78XX regulators are the three-terminal devices that provide a fixed positive output voltage.





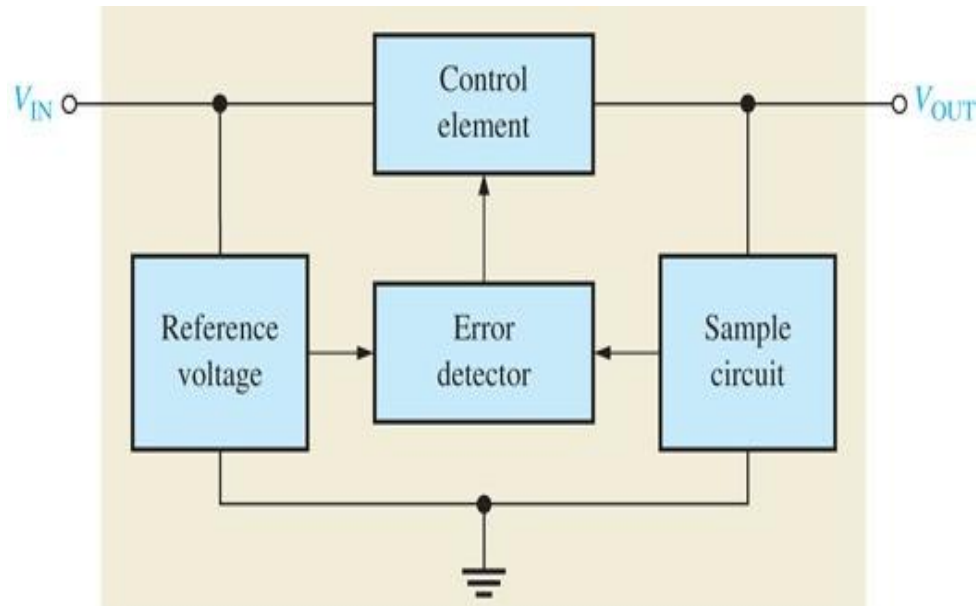
Fixed Voltage Regulator

- An unregulated input voltage Vi is filtered by a capacitor C_1 and connected to the IC's IN terminal.
- The IC's OUT terminal provides a regulated +12 V, which is filtered by capacitor C_2.
- The third IC terminal is connected to ground (GND)



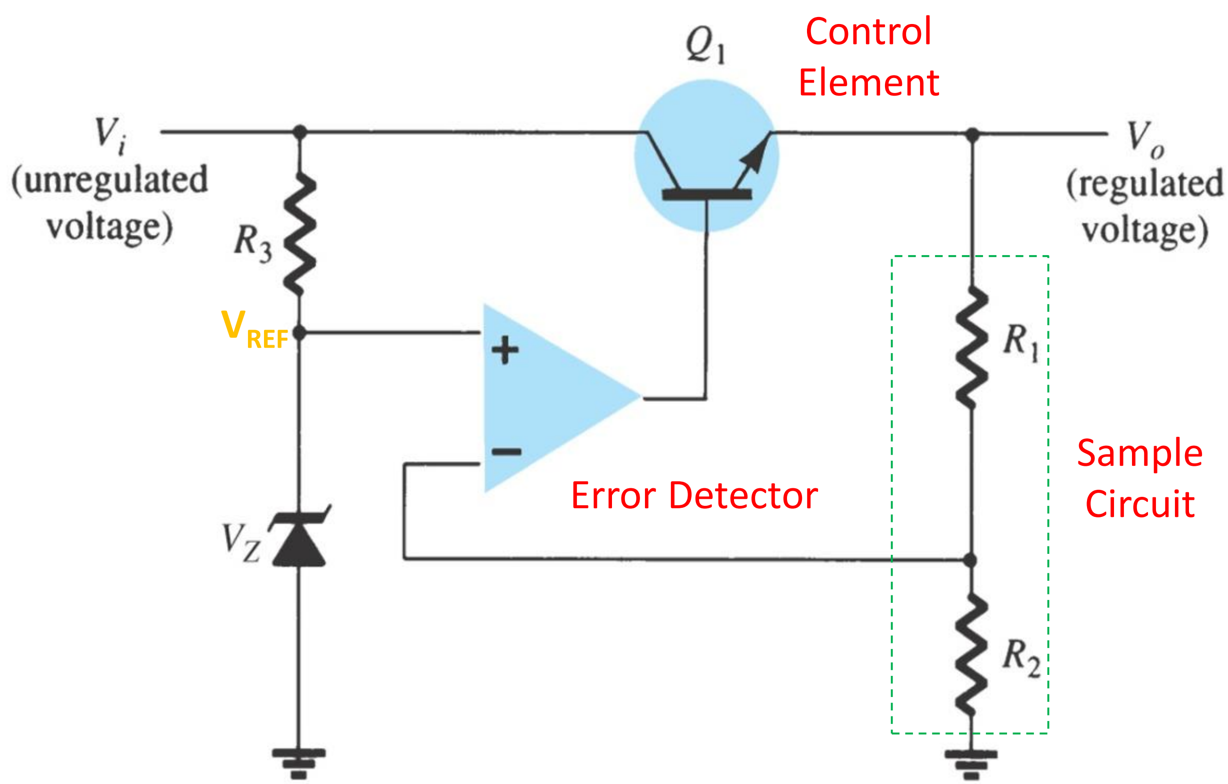
Series Regulator Circuit

- Control element in series with load between input and output.
- Output sample circuit senses a change in output voltage.
- Error detector compares sample voltage with reference voltage → causes control element to compensate in order to maintain a constant output voltage.



- The resistor R1 and R2 sense a change in the output voltage and provide a feedback voltage.
- The error detector compares the feedback voltage with a Zener diode reference voltage.
- The resulting difference voltage causes the transistor Q1 controls the conduction to compensate the variation of the output voltage.
- The output voltage will be maintained at a constant value of:

$$V_o = \left(1 + \frac{R_1}{R_2}\right) V_Z$$



Fixed Voltage Regulator

Positive-Voltage Regulators in the 78XX Series

IC Part	Output Voltage (V)	Minimum V_i (V)
7805	+5	+7.3
7806	+6	+8.3
7808	+8	+10.5
7810	+10	+12.5
7812	+12	+14.5
7815	+15	+17.7
7818	+18	+21.0
7824	+24	+27.1

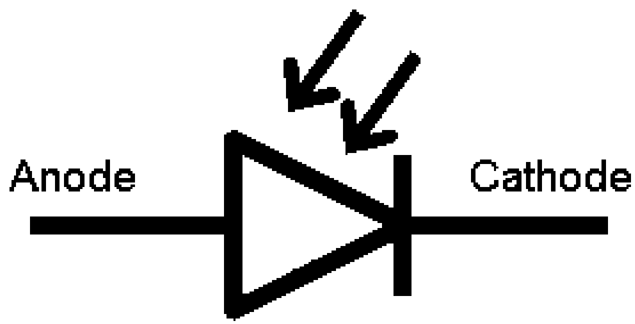
PHOTO DIODE

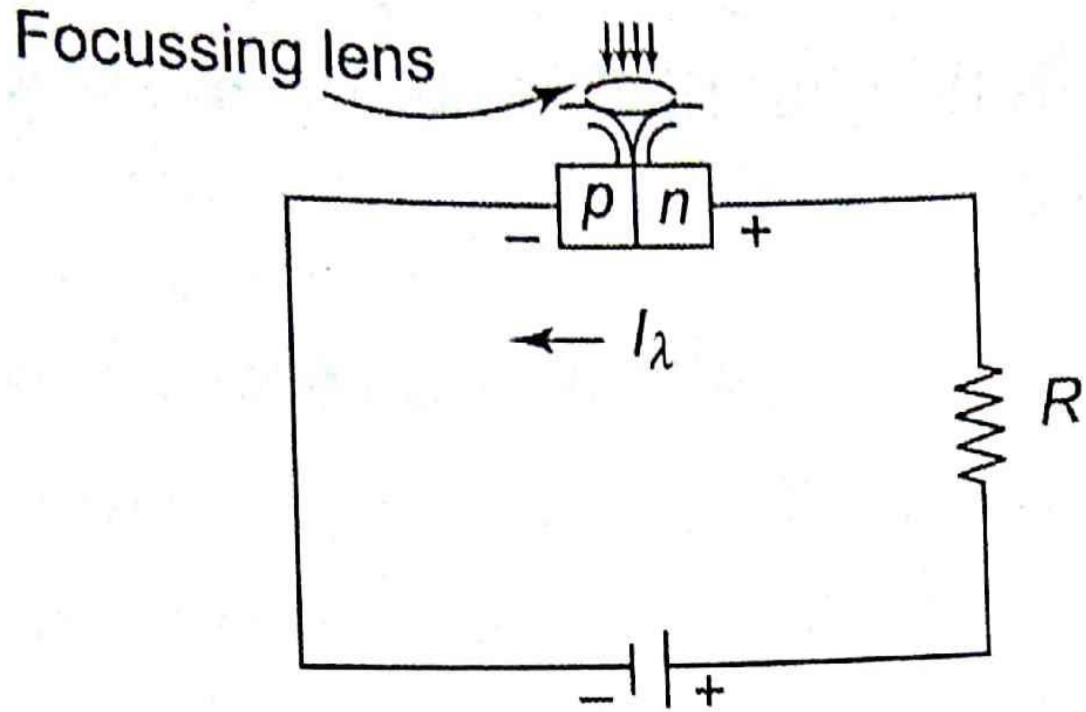
- It is a PN junction or PIN semiconductor device that converts light into electric current.
- Light controls diode current
- It operates in reverse bias.
- Construction and working is almost similar to the normal PN junction diode.
- PIN structure provides fast response time.

- The reverse saturation current $I\lambda$ (μA) is limited by the availability of thermally generated minority carrier
- As light is made to impinge on the junction, the light photons impart energy to the valence electrons causing more electron-hole pairs to be released.
- As a result, the concentration of the minority carriers increases which in turn increases the reverse saturation current I_λ.

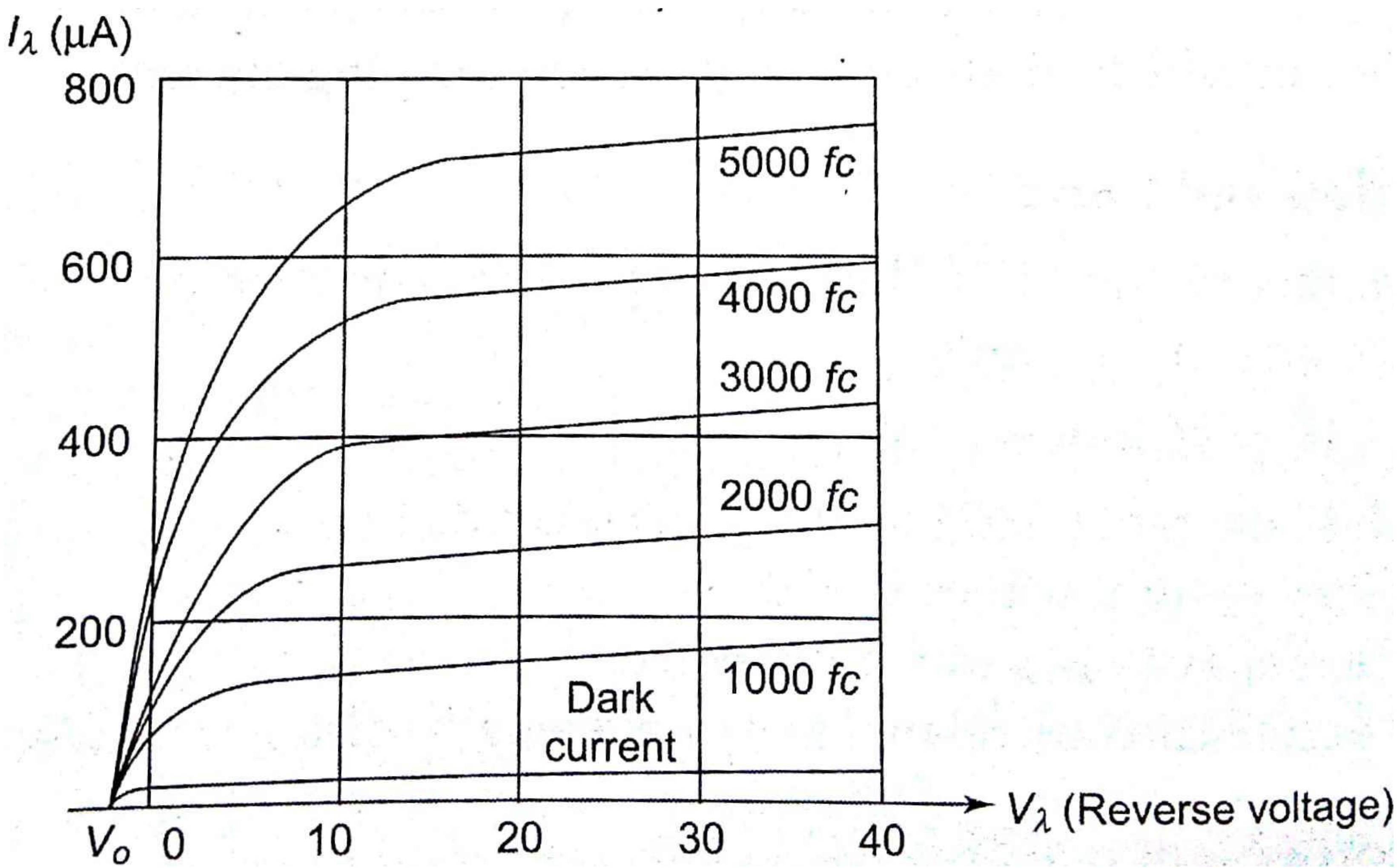
The symbol and circuit for photo diode are shown below

SYMBOL





VI Characteristics of Photodiode



- Almost equal spacing between the curves indicates that an increase in light intensity results in a similar increase in reverse current.
- Dark current is the one when no light is applied.
- The current becomes zero when a small positive bias voltage V_T is applied across the photodiode.

Applications of photodiodes:

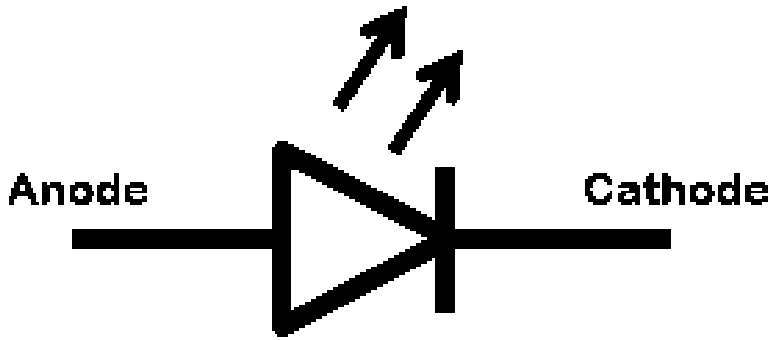
- Optical communication systems
- Automotive devices
- Solar cell panels
- Consumer electronics like CD players, TV and remote controls
- Measurement of light intensity
- Camera light meters and street lights
- Photo detection circuits
- Logic circuits and analysers

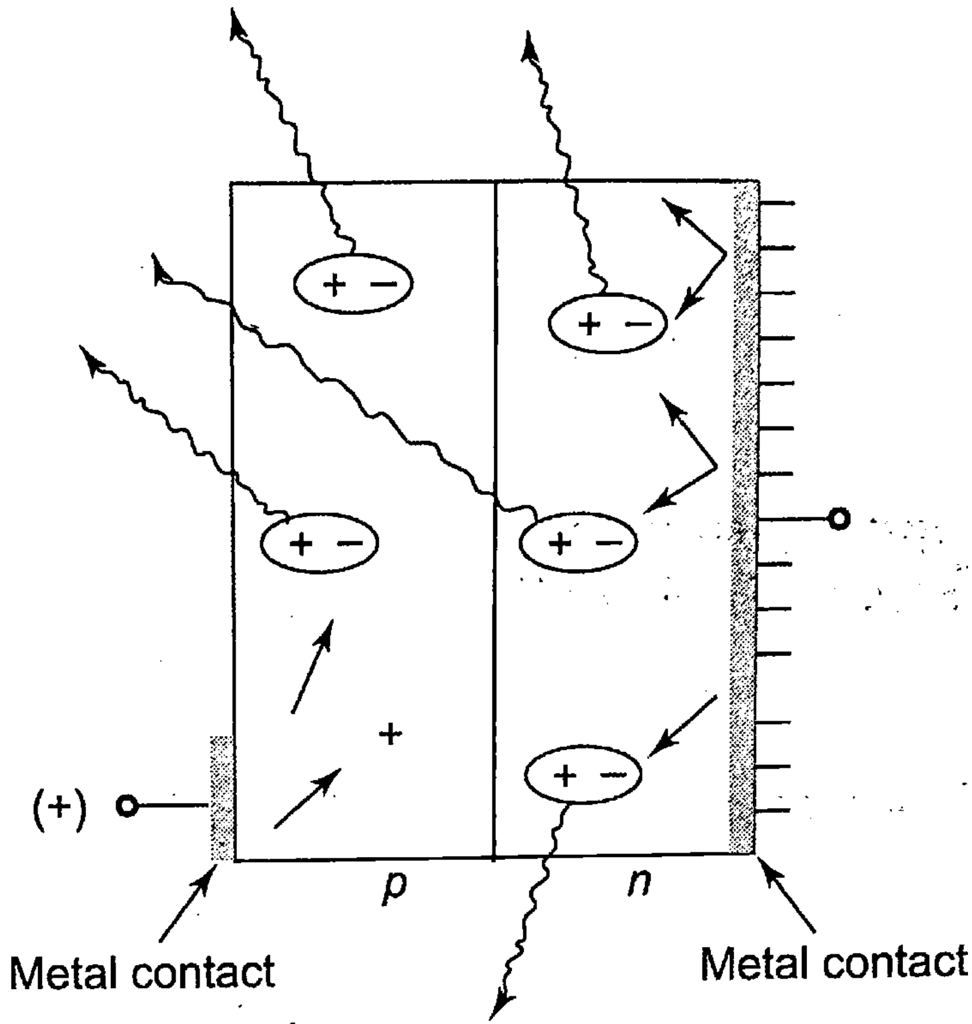
LIGHT EMITTING DIODE (LED)

- ***Electroluminescence,*** is the phenomenon where light is emitted from a PN junction semiconductor under the influence of an electric field.
- Recombination of electrons and holes in a forward biased PN junction is always associated with the release of energy either in the form of heat or light.
- Electrons dissipate energy in the form of heat in the case of Si and Ge.

- In the case of gallium arsenide (GaAs), gallium phosphide (GaP), electrons dissipate energy in the form of light.
- Thus, the PN junction becomes the source of light and hence it is called Light Emitting Diode (LED).
- When the junction is reverse biased the LED produces no light.
- GaAs emit infrared (IR) radiation which is invisible.
- GaAsP emits either red or yellow visible light.

Symbol and light emission of LED are shown below





- Colour of the emitted light (wavelength) depends on the impurities and the level of doping while fabricating.
- Typical value of forward bias voltage across the LED is 1.2V to 3.2V.
- The light output is directly proportional to the forward current.

Advantages of LED

- Lower energy consumption
- Longer life time
- Improved physical robustness
- Smaller size
- Faster switching

Applications of LED

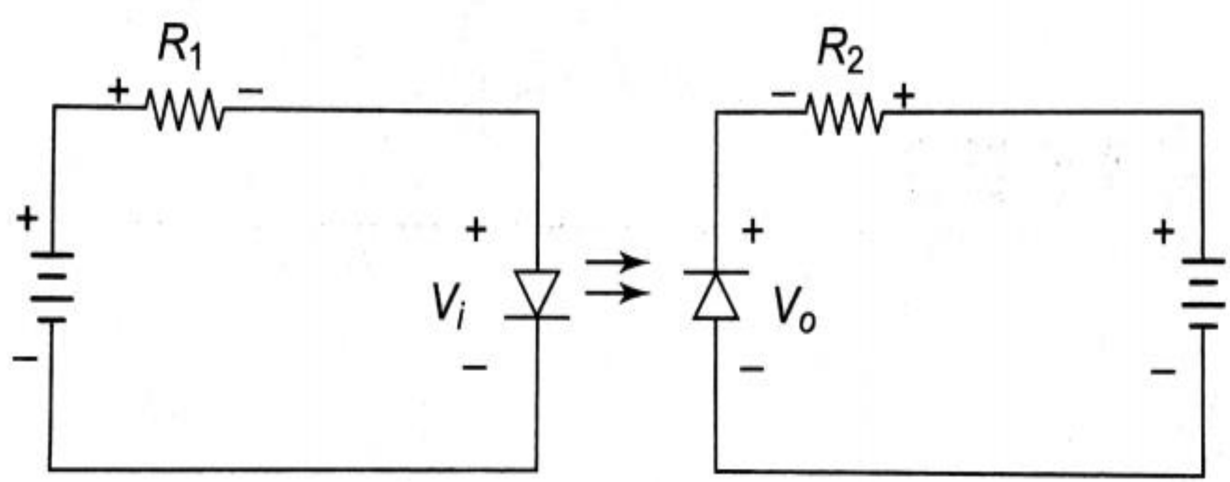
- 7- segment display
- Automotive head lamps
- Traffic signals
- General lighting
- Camera flashes
- Medical devices
- LED TV’s etc.

PHOTOCOUPLER

- Transformers provides “electrical isolation” between the primary input voltage from the secondary output voltage using electromagnetic coupling and this is achieved using the magnetic flux circulating within their laminated iron core.
- But we can also provide electrical isolation between an input source and an output load using just light by using a very common and valuable electronic component called an Photocoupler.
- It consists of an farward biased LED that produces infra-red light and a semiconductor photo-sensitive diode that is used to detect the emitted infra-red beam.

PHOTOCOUPLER

- It is a package of an LED and photodiode where as circuit is electrically isolated as shown in Figure
- Output is available across Resistor R2.



PHOTOCOUPLER

Advantage:

- Provides the required electrical isolation between a lower voltage control signal and a much higher voltage or mains current output signal.
- Used to detect the operation of the switch or another type of digital input signal.

Application:

- Microprocessor input/output switching, DC and AC power control, PC communications, signal isolation and power supply regulation which suffer from current ground loops, etc.