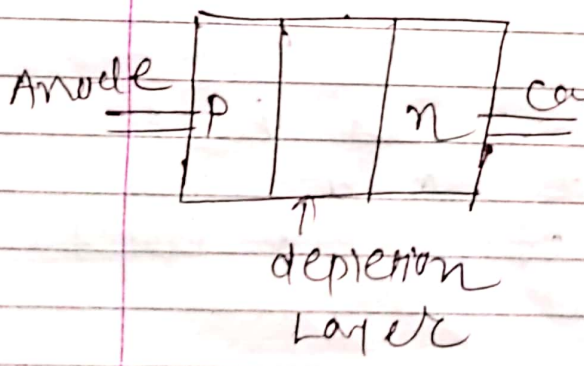
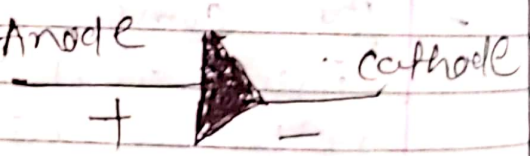
* What is Diode?

Diode is two terminal electronic device, which passes current only in one direction.



[Basic structure]



(symbol)

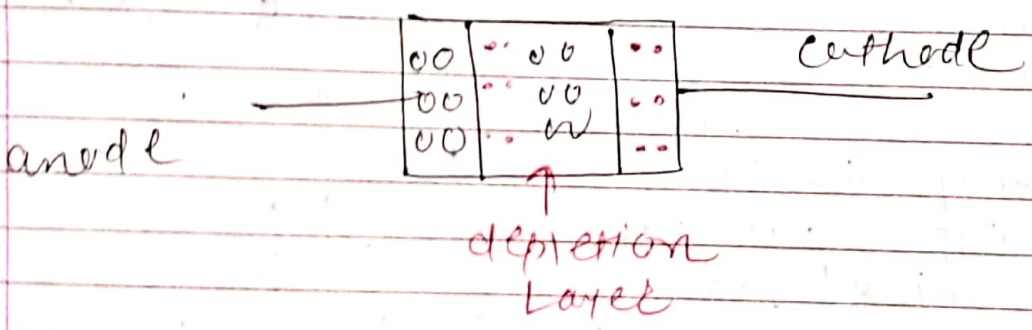
→ One terminal is anode and other terminal is cathode.

- current flows from anode to cathode.

Note: It has high resistance at one direction and low resistance at other direction.

⇒ Low resistance at direction of flow of current and high resistance at high opposite direction of flow of current.

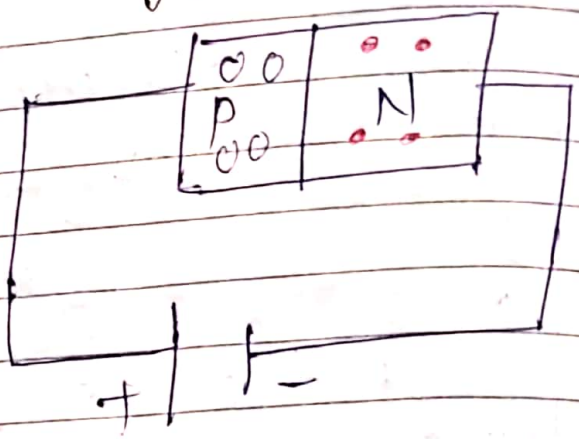
* P-N Junction Diode:-



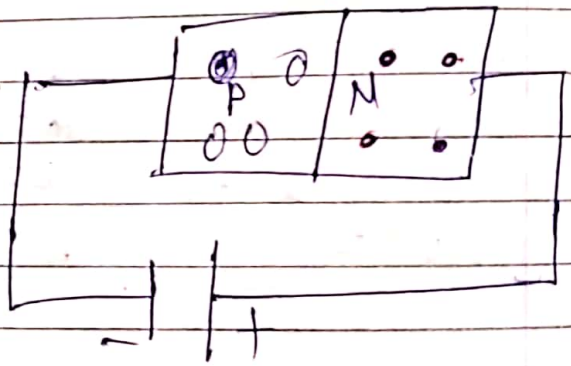
→ During formation of depletion layer some free e^- travels, so few amount of current will flow there. and after equilibrium state no current will flow.

⇒ TO Find flow of current we have to connect battery to the P-N junction diode.

* How current will flow in p-N junction diode, when is forward, Reverse biasing?

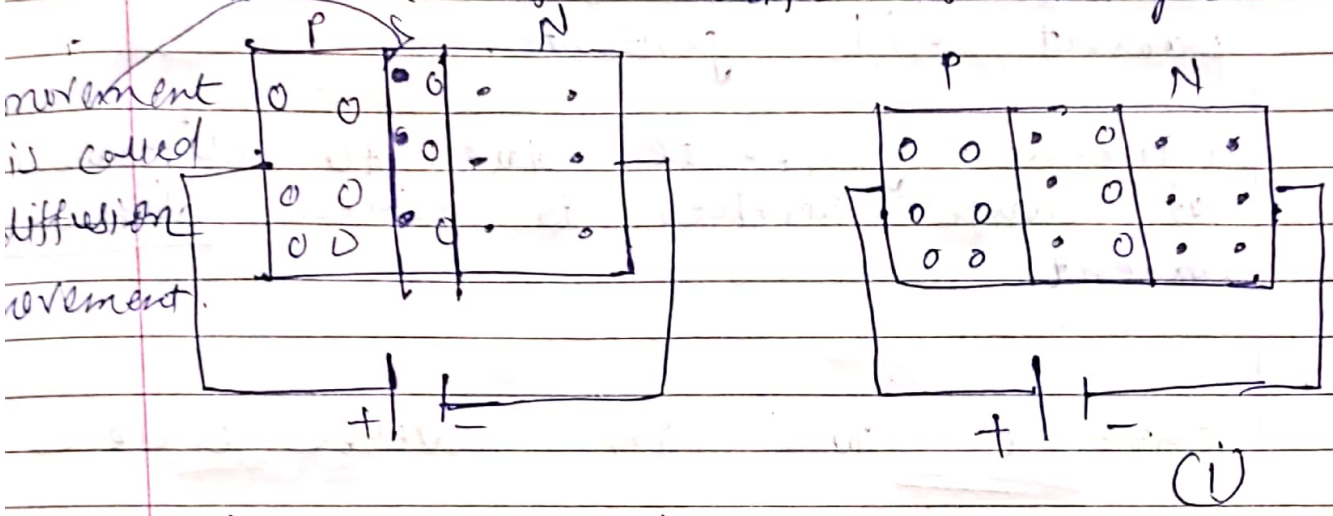


- When we connect positive terminal of battery to the P-type and -ve terminal of battery to the N type then this type of connection or biasing is known as Forward Biasing.



- When we connect -ve terminal of battery to the P-type and +ve terminal of battery to the N type, this type of biasing is known as Reverse biasing.

* Flow of current across forward biased junction is mainly due to
- ~~drift of charges~~
- diffusion of charges.
- ~~diffusion of~~ drift ~~of~~ charges.



movement is called ~~diffusion~~ movement.

(i)

When, external source is applied means +ve terminal is connected to p type and - ve terminal - is connected to N type the ~~neo~~ depletion Region is formed.

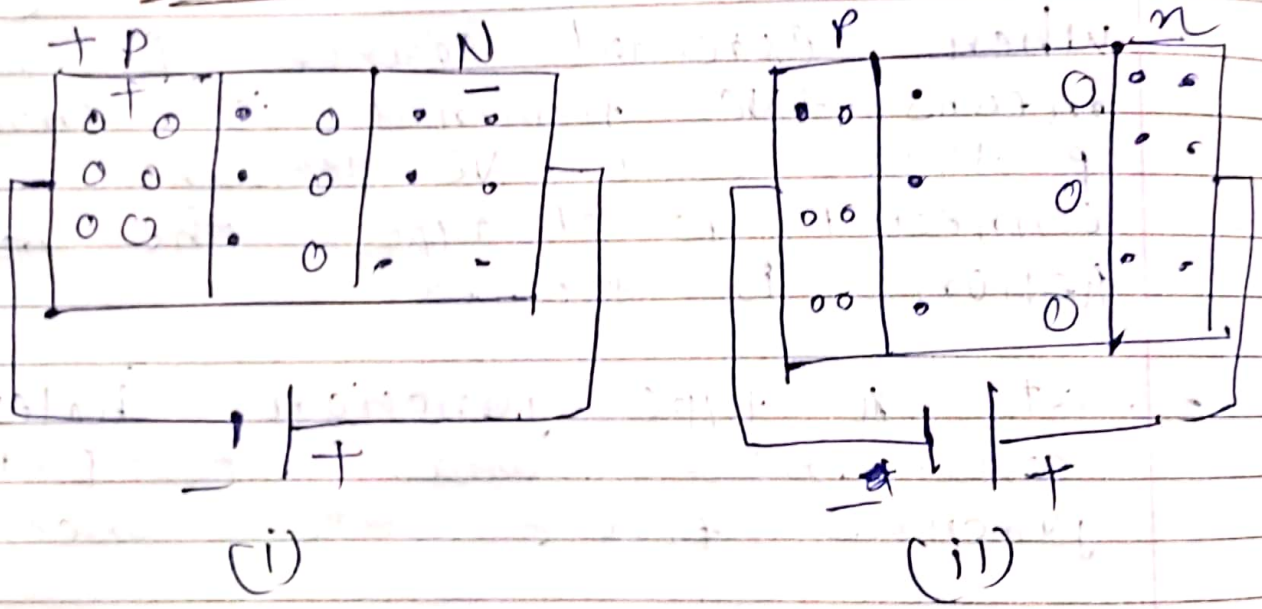
- at N type junction, holes are concentrated and at P-type junction free e^- are concentrated.
- movement of holes ○ are from
  - P to N type
  majority to minority
- movement of free e^- are from
  N to P type
  - minority to majority
- this movement is known as diffusion movement.

- at a junction free electrons and holes are concentrated. so they combined to each other and this is known as diffusion.

- By combination of e^- and holes current will generate.

- current generate due to diffusion of charge carriers is called diffusion current.

* current flow in Reverse biased



(i) (ii)

- Here in reverse bias condition -ve terminal is connected to the p type and +ve terminal is connected to n type.

- when external source is connected

→ holes are +vely charged and free e^- are -vely charged.

voltage ↑ → depletion layer ↑ R.B

voltage ↑ → depletion layer ↓ F.B

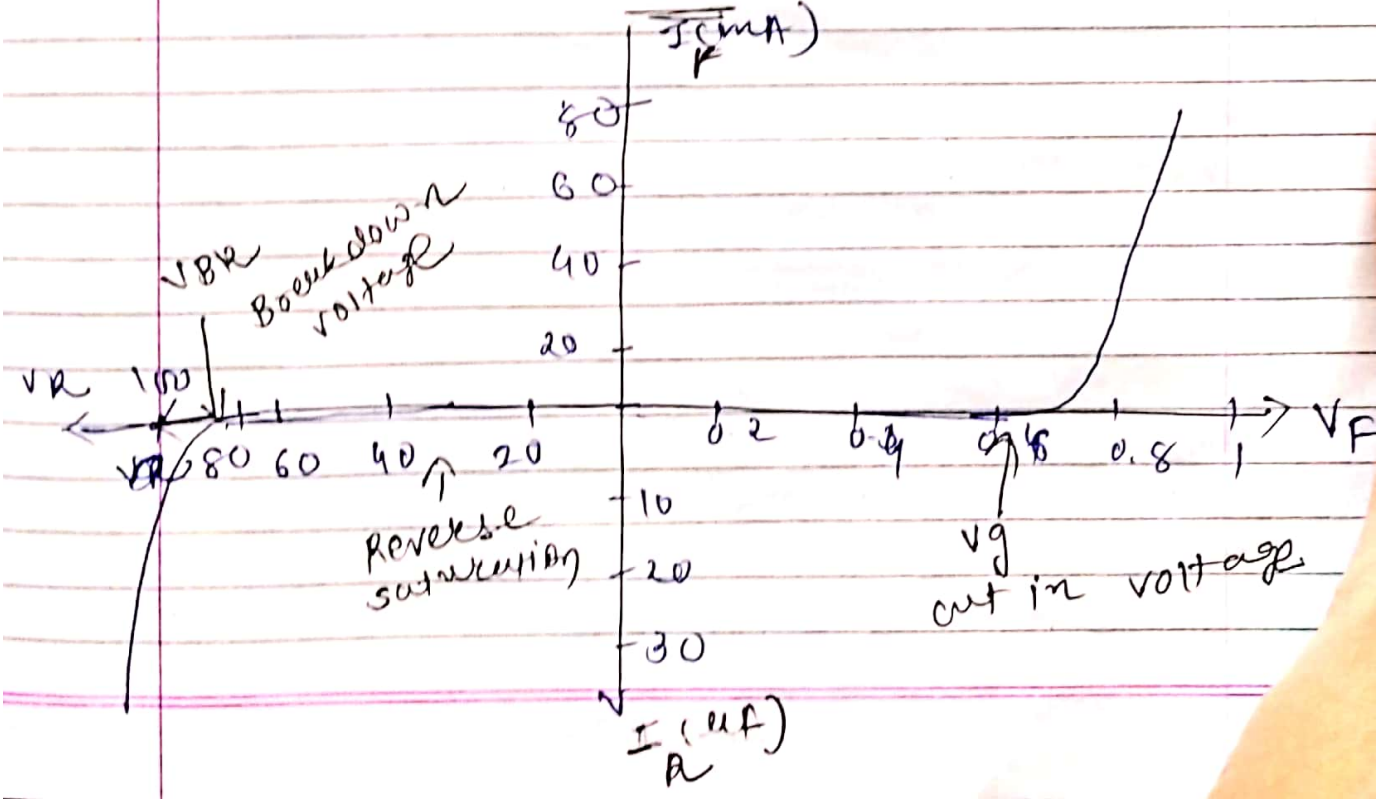
When external source applied holes attracted toward -ve potential on p-n, i.e. attracted toward +ve side due to this diffusion layer incr depletion ∴ depletion Diffusion layer become thicker.

→ If material is made up of Si barrier potential is 0.7 V.

- Here ~~Dif~~ depletion layer is thick so current can not flow. so there is no movement of e^- and holes.

- So, In Reverse bias current will block when voltage source is applied.

* V-I Characteristics of P-N Junction



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- Reverse bias break down voltage.

By increasing voltage depletion layer also increases. but at one voltage depletion layer will breakdown that voltage is known as depletion layer breakdown voltage. of Reverse biased. (VBR)

* Effect of temperature on the V-I characteristics.

* Diode Resistance.

- Resistance of diode is non-zero and ~~infinite~~, as diode is not a perfect conductor nor it's a perfect insulator.

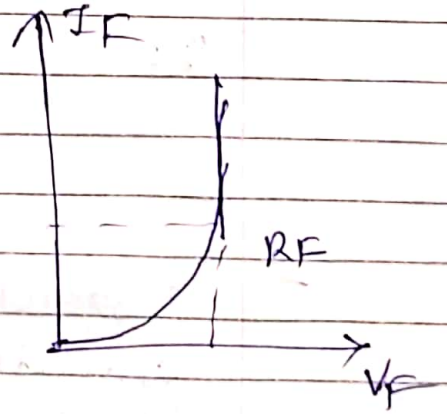
- Static resistance
  Dynamic resistance.

* Static or D.C Resistance.

- When DC voltage is applied to the diode D.C current will flow.

(V-I) Characteristics of diode will not change with time
means curve of the diode will not change it's with time.
And
The resistance offered in this condition is known as D.C Resistance or static resistance.

$$R_F = \frac{V_F}{I_F}$$



It is the ratio of VF ~~and~~ to IF

Typic value of Foward Resistance RF is between 10Ω to 50Ω.

* A.C or dynamic Resistance.

- When A.C voltage is applied to the diode A.C current will flow and operating point of diode also changes with respect to time.

- And resistance offered in this condition is known as A.C. or dynamic resistance.

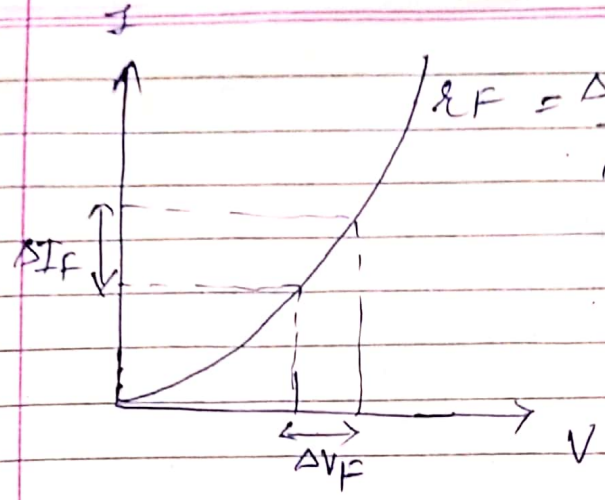
Dynamic resistance

$$r_f = \frac{\Delta V_F}{\Delta I_F}$$

→ It is also defined as reciprocal of slope of the forward characteristics.

$$r_f = \frac{1}{\text{slope of the characteristics.}}$$

- Current flowing in reverse biased condition is very low, so resistance offered is very high.



* Ideal diode:

- Ideal diode is a p-n junction diode which offered zero resistance in forward bias. (i.e current will flow easily in forward)

- Ideal diode is a p-n junction diode which offered infinite (maximum) resistance in reverse bias (i.e current will block in reverse bias)

→ Act as perfect conductor

Act as perfect ~~conductor~~ Insulator.

In Reverse bias means high resistance offered (NO current flow) so, diode is act like open switch

* In forward bias it's act like close switch or act as S.C short circuit.

Forward bias

close S/w or S.C

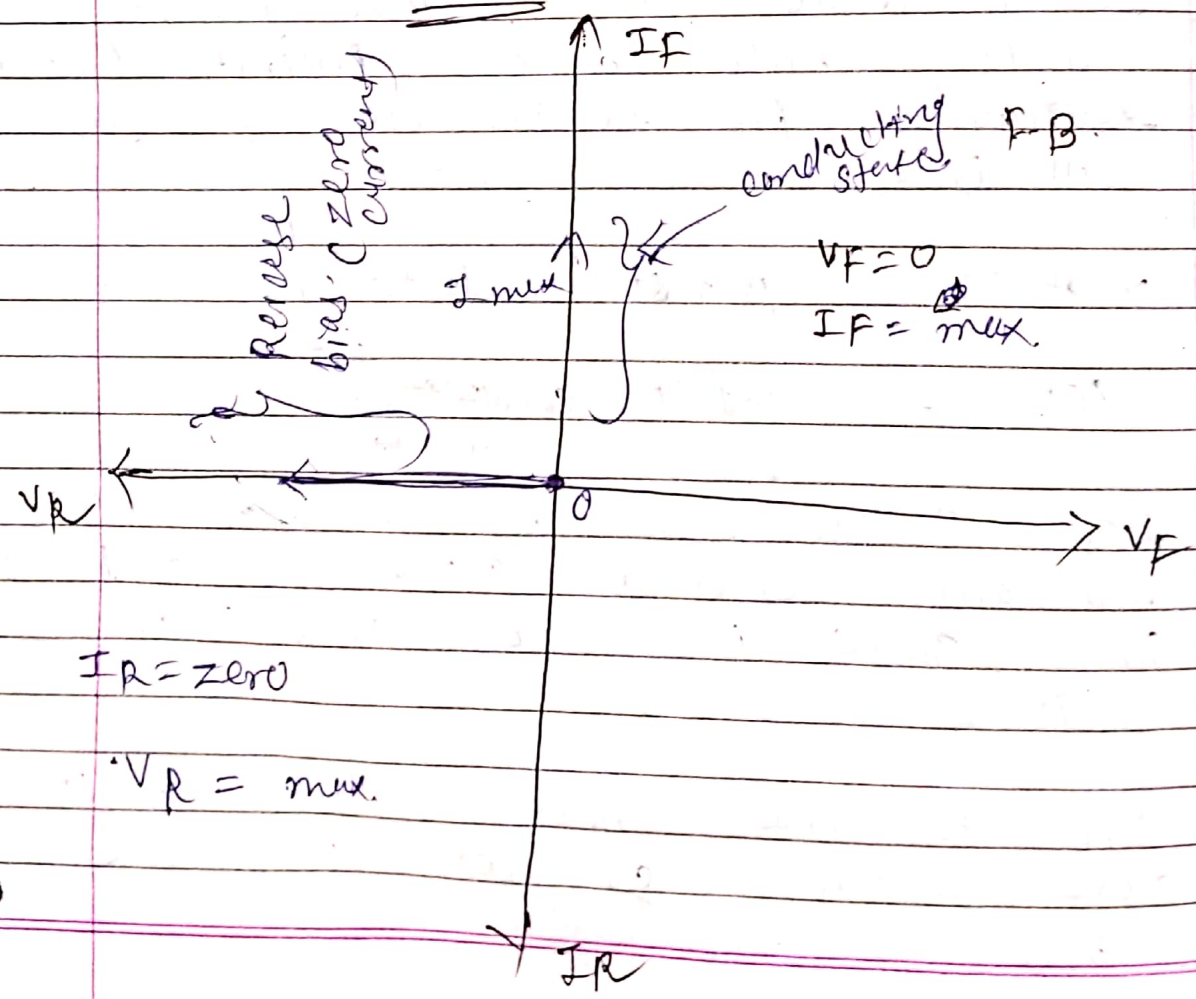
V=0 R=0

Reverse bias.

open S/w or O.C

R=∞ I=0

Characteristics of Ideal diode



I_R = zero

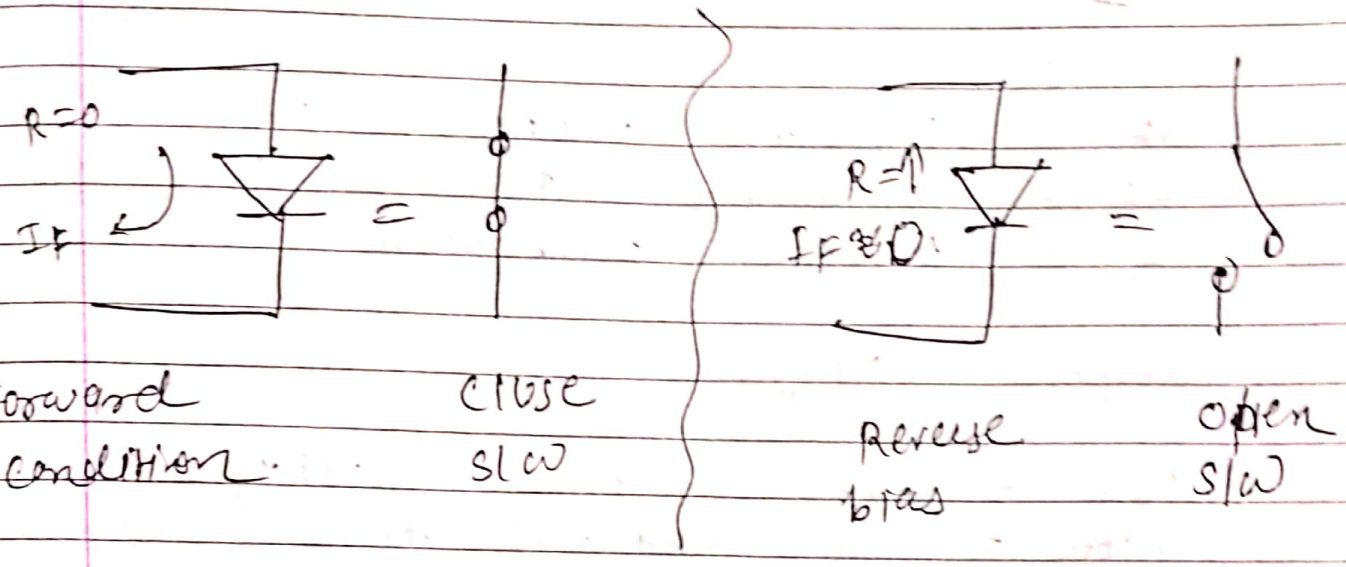
V_R = max.

R.B

R=∞

I=0

* diode as a switch-



Forward condition — Close S/W

Reverse bias — open S/W

Forward condition diode act as a close S/W because current flows and resistance offered is very low.

- Reverse condition Diode act as open switch, and current = 0
  Resistance offered = ↑

* PIV (Peak inverse voltage)

⇒ The maximum value of applied voltage when diode is in reverse bias condition.

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Reading of datasheet:

Diode specification

V_F = Forward voltage
I_F = maximum Forward current.
I_S = Reverse saturation current

Reverse Voltage

PIV - peak inverse voltage
V_{RRM} = peak Repetitive reverse voltage
- maximum power dissipation
- operating temperature range

On which parameter diode is selected.

FAIRCHILD
SEMICONDUCTOR®

1N4001 - 1N4007

Features

- Low forward voltage drop.
- High surge current capability.

DO-41
COLOR BAND DENOTES CATHODE

General Purpose Rectifiers

Absolute Maximum Ratings*

T_A = 25°C unless otherwise noted

Symbol	Parameter	Value							Units
		4001	4002	4003	4004	4005	4006	4007	
V_{RRM}	Peak Repetitive Reverse Voltage	50	100	200	400	600	800	1000	V
$I_{F(AV)}$	Average Rectified Forward Current, .375 " lead length @ T_A = 75°C	1.0							A
I_{FSM}	Non-repetitive Peak Forward Surge Current 8.3 ms Single Half-Sine-Wave	30							A
T_{stg}	Storage Temperature Range	-55 to +175							°C
T_J	Operating Junction Temperature	-55 to +175							°C

*These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

Thermal Characteristics

Symbol	Parameter	Value	Units
P_D	Power Dissipation	3.0	W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	50	°C/W

Electrical Characteristics

T_A = 25°C unless otherwise noted

Symbol	Parameter	Device							Units
		4001	4002	4003	4004	4005	4006	4007	
V_F	Forward Voltage @ 1.0 A	1.1							V
I_{rr}	Maximum Full Load Reverse Current, Full Cycle T_A = 75°C	30							µA
I_R	Reverse Current @ rated V_R T_A = 25°C T_A = 100°C	5.0 500							µA µA
C_T	Total Capacitance V_R = 4.0 V, f = 1.0 MHz	15							pF

(*a*)

3.20 Diode Data Sheet Specifications :

- A manufacturers data sheet gives detailed information on a device so that the user can use it properly in a given application.
- A typical data sheet provides the following specifications of a device :
  1. Maximum ratings
  2. Electrical characteristics
  3. Mechanical data
  4. Graphs of various parameters
- Refer Table 3.20.1. It provides the maximum ratings for a particular diode 1N 5395.

Table 3.20.1 : Maximum ratings

Sr. No.	Rating	Symbol	Value	Unit
1.	Peak inverse voltage	PIV	– 400	Volts
2.	Maximum reverse current at PIV	I_o	300	μA
3.	Maximum dc forward voltage (at 5A)	V_F	1.4	Volts
4.	Average half wave rectified forward current	I_{FR}	1.5	A
5.	Nonrepetitive peak surge current (For 1 cycle)	I_{FSM}	30	A
6.	Maximum junction temperature	$T_{j\,(max)}$	170°	C

- The current derating curve is shown in Fig. 3.20.1(a) and the typical volt ampere characteristics is shown in Fig. 3.20.1(c).