ZENER DIODE

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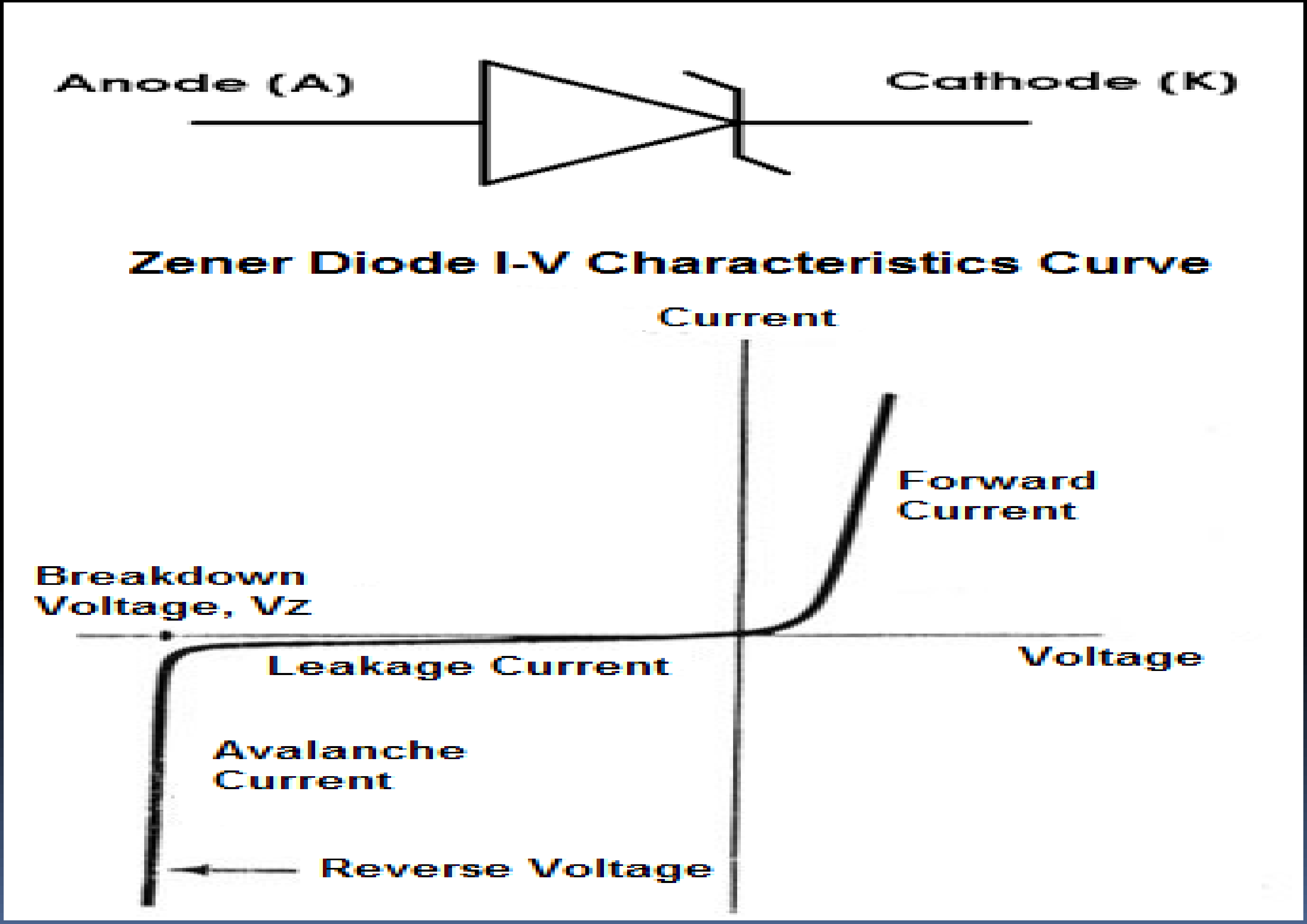
INTRODUCTION

- Zener diode is a PN junction diode.
- It is special purpose diode
- It is constructed for definite breakdown voltage.
- The breakdown voltage depends on the doping density of P and N type semiconductor.
- Thus by changing the amount of doping zener diode can be constructed for different breakdown voltage.

SYMBOL & I-V CURVE



CONSTRUCTION

- A zener diode for a particular break down voltage is constructed by a specific doping such that it can operate at the reverse break down voltage without being damaged and the junction is restored to it’s original conditions when the reverse voltage is removed.
- The zener breakdown voltage decreases with the increase in doping.

ZENER CHARACTERISTICS

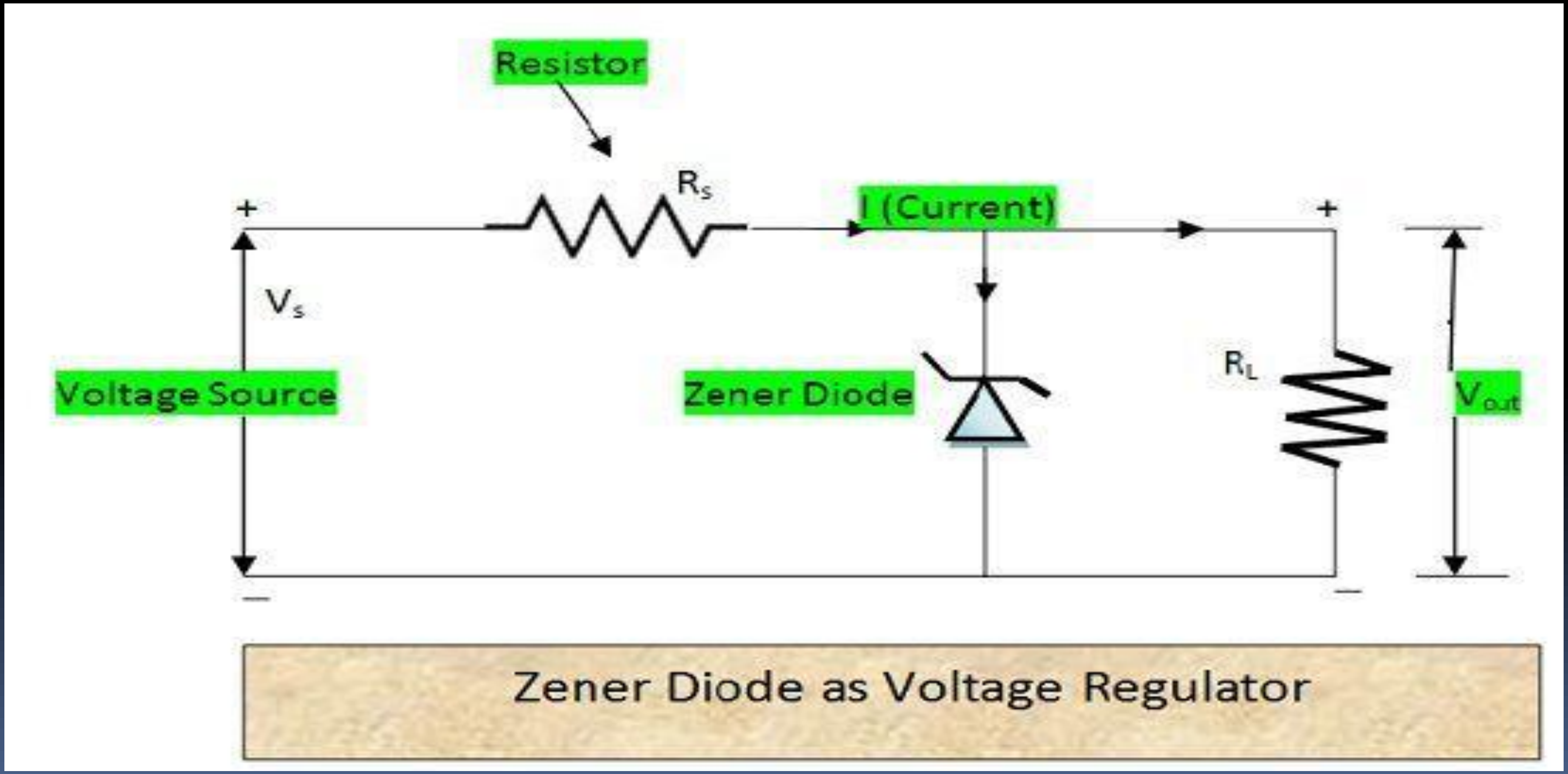
- In figure 2 the dotted line in reverse bias is nearly parallel to the current axis which implies that, the potential difference almost remains constant even if the current through the zener diode changes.
- Thus the potential on a zener diode behaves as a reference.
- Hence this diode is also called a reference diode.
- It is mainly used in circuits where constant voltage is required and current demand is very large, as a voltage regulator.

WORKING PRINCILPLE

- We have read that the junction of zener diode is thin and so a strong electric field is produced even when a low reverse bias voltage is applied.
- On increasing the temperature, the forbidden energy gap reduces and the zener breakdown now begins to occur at a low voltage.
- At the zener voltage, the resistance of diode abruptly falls and , therefore, the reverse current suddenly increases.
- When the reverse voltage is withdrawn, the junction of diode regains back it’s original state.

ZENER DIODE AS VOLTAGE REGULATOR

The zener diode is connected in reverse biased condition.



APPLICATION OF ZENER DIODE AS VOLTAGE REGULATOR

- Let in the figure I is the source current , Iz be the zener current and Il be the current due to load resistance, then according to kirchof's law:

$$I = I_Z + I_L$$

and $$V_0 = V - IR$$ ....(1

or $$V_0 = I_L R_L$$

- 1st situation – If supply voltage is constant & load resistance vary .
- 2nd situation – If load resistance is kept constant & supply voltage vary.

IN 1ST SITUATION-
Supply voltage is constant & load resistance vary

Since Zener voltage V_0 is contant,

hence, $\delta I = 0$ from equation $V_0 = V - IR$

but $\delta I = \delta I_z + \delta I_L$ from equation $I = I_Z + I_L$

Hence, $\delta I_z + \delta I_L = 0$ or $\delta I_Z = -\delta I_L$

Thus keeping the supply voltage contant, if load resistance is incresed, the zener current **Iz** increases by the same amount as the load current **IL** decreases so that the total current **I** remains constant.

2^{nd} situation –

Load resistance is kept constant & supply voltage vary.

Since Zener voltage V_0 is contant,

hence, $\delta V = -R\delta I$ from equation $V_0 = V - IR$

and $\delta I_L = 0$ from equation $V_0 = I_L R_L$

Hence, $\delta I = \delta I_Z \; from \; I = I_Z + I_L$

i.e., at contant load resistance **RL**, change in supply voltage provides equal change in total current **I** and zener current **Iz**, but load current **RL** remains constant

THANK YOU