



SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF COMPUTER SCIENCE AND DESIGN

COURSE NAME : 19EE01 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

I YEAR /II SEMESTER - COMPUTER SCIENCE AND DESIGN

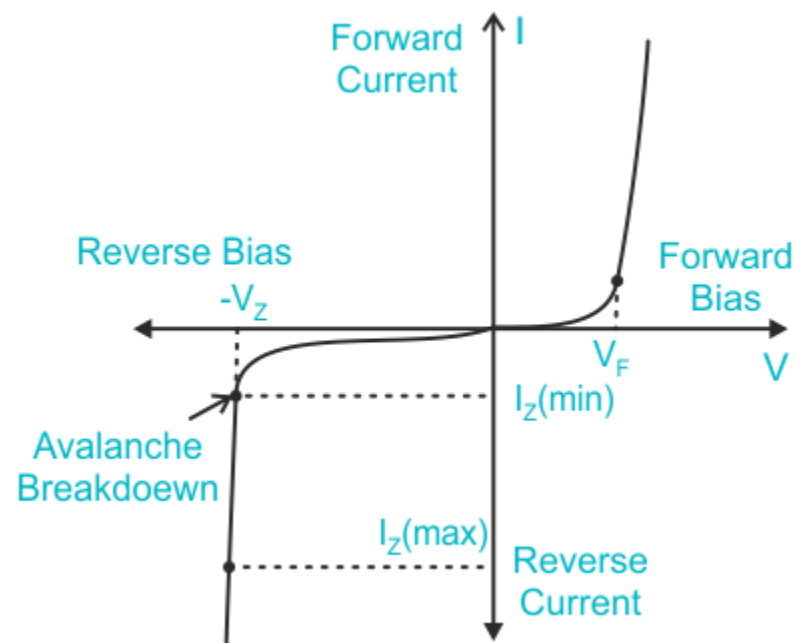
Unit 4 – ANALOG ELECTRONICS

Topic 8 : Voltage regulators

Zener Diode as a Voltage Regulator

When provided reverse bias feedback, the Zener diode operates as a voltage regulator, generating a little leakage current till a constant voltage is achieved. A Zener diode has a typical current flow from anode to cathode. The Zener diode behaves like a general-purpose diode with a silicon PN junction whenever loaded in a forward direction. This forward flow can be reversed if the voltage surpasses a particular limit. The constant voltage aids the Zener diode's voltage regulation.

V-I Characteristics of Zener Diode





We can see that the Zener diode has an area in its reverse bias characteristics where a continuous negative voltage emerges independent of the current that flows through the diode from the V-I characteristic curve. Even when the current changes dramatically, the voltage remains constant. A Zener diode's capacity to manage itself can be utilised to regulate or stabilise the voltage source in the face of supply or load fluctuations. Because of this feature, a voltage regulator can be made out of a Zener diode operating in the breakdown zone.

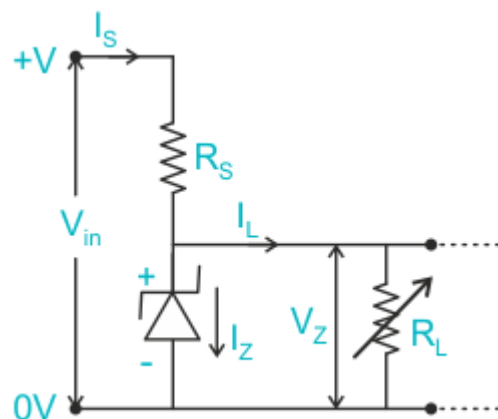
The Zener diode's capacity to manage itself can be utilised to moderate or maintain a voltage source in the face of supply or load changes. Because it can be utilised in the simplest forms of voltage regulator applications, the fact that now the voltage across the diode inside the breakdown zone seems to be almost constant turns out to be a significant feature of the Zener diode. A voltage regulator's job is to deliver a constant voltage to a load parallel connection with it, regardless of supply voltage waves or load current fluctuations.

Working of Zener Diode as a Voltage Regulator

The capacity of a Zener diode to keep a constant voltage regardless of changes in source or load current is critical in this application. A voltage regulation device's general role is to give a constant output voltage to a load connected in parallel to it, regardless of variations in the load's energy drawn (Load current) or fluctuations and instability in the supply voltage. If the current remains within the limit of the min and max reverse currents, the Zener diode will produce a constant voltage.



To restrict the current that flows through the Zener diode, a resistor R_s is connected in series with the diode, and also the input voltage V_{in} is connected across as shown in the image, and the output voltage V_{out} is chosen to take across the Zener diode with $V_{out} = V_z$. Because the reverse bias features of the Zener diode are required to control the voltage, it is wired in reverse bias mode, and with a cathode linked to the circuit's positive rail.



Whenever the load is connected, a small valued resistor would result in a big diode [current and electricity](#), which would raise the power dissipation need of the diode, which could exceed the Zener's maximum power rating and harm it.



The value of the resistor can be determined by the formula

$$R_S = \frac{(V_{in} - V_Z)}{I_Z}$$

Where, R_S is the value of series resistance and V_{in} is the input voltage and V_Z is Zener voltage.

Using this method, it is simple to assure that the resistor value chosen does not result in a current flow greater than the Zener can tolerate.

One minor issue with Zener diode-based regulatory circuits is that although attempting to moderate the input voltage, the Zener might generate electrical noise just on the supply rail. Although it may not be a problem in most cases, a big value decoupling capacitor placed across the diode may address the problem. This helps to keep the Zener's output stable.

Application of Zener Diode as a Voltage Regulator

The following are some of the most important applications of a Zener voltage regulator.

- Within the emitter follower regulator, a Zener voltage regulator is used.
- It is utilised with a modest load current range and maintains a steady output DC voltage.
- It is used to control or change the circuit's output voltage.
- It is employed in analog and digital circuits that need to be precise with their references.
- It is utilised in current source and sink circuits.
- It is used to fine-tune linear and switch power supply voltage and current.
- Error amplifiers use it as well.



Disadvantages of using Zener Diode as a Voltage Regulator

There are two major disadvantages to using a Zener diode as a voltage regulator

- Zener diodes waste electricity by cancelling voltages by applying even higher voltages in the opposite direction.
- Furthermore, Zener diodes have a low regulation ratio and are often inferior to transistors.



REFERENCES

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THANK YOU