SAWA UNIVERSITY

عنوان المحاضرة:Zener Diode

جامعة ساوة

كلية التقنية الهندسية

القسم الاجهرة الطبية

المرحلة الثانية

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Zener Diode

The Zener diode acts just like a normal diode when forward biased, but when a reverse voltage is applied, the voltage across it remains constant, where that happens when the applied reverse voltage is higher than the Zener voltage Vz.

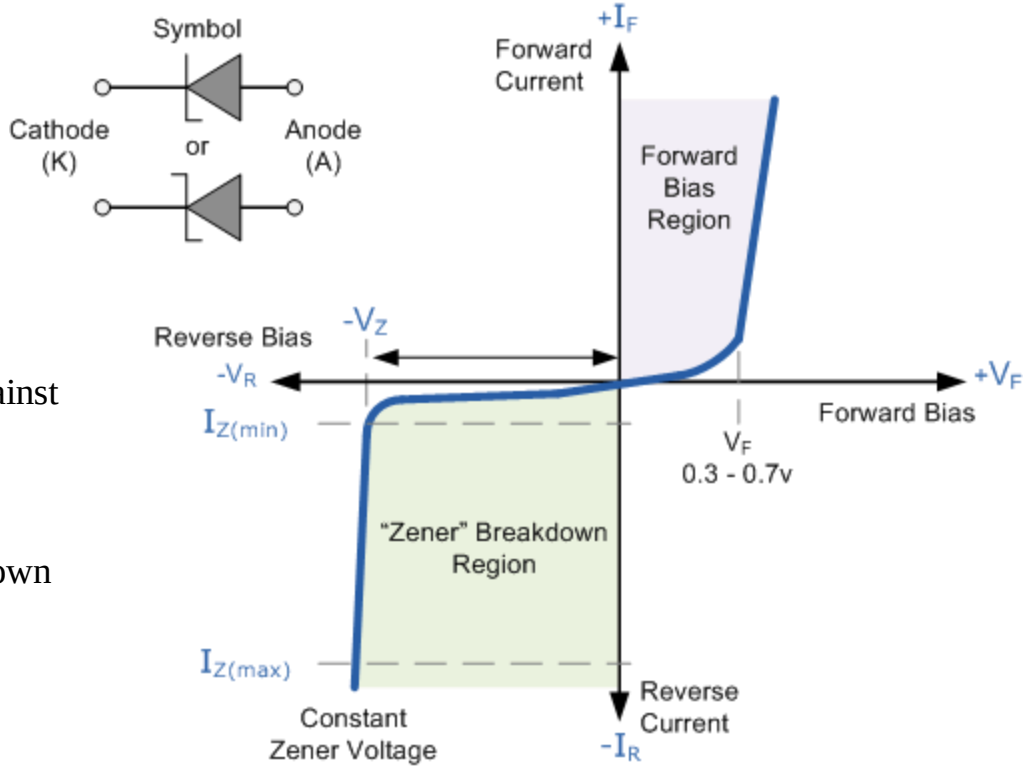
Reverse voltage can be increased even after the breakdown voltage is reached. At this point, maximum current will flow through the Zener diode. This breakdown point is referred to as "Zener voltage".

From the I-V Characteristics, we see that the Zener diode has a region in its reverse bias half (left half) in which There is a constant negative voltage even with large changes in current.

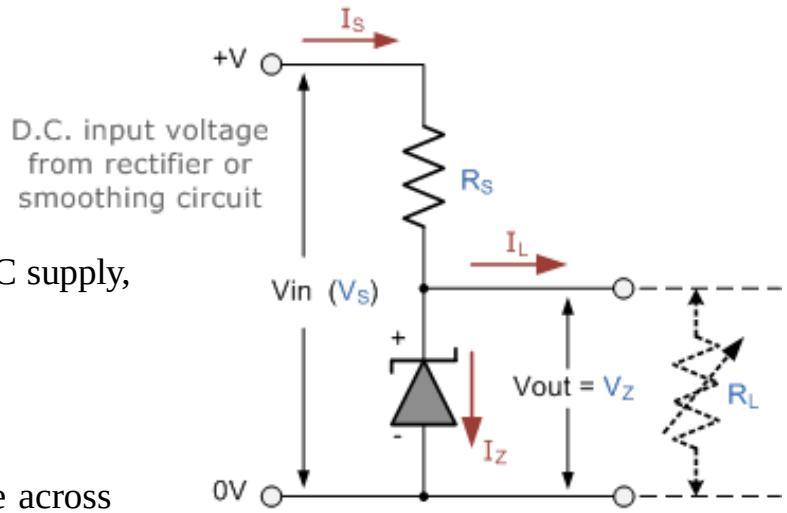
This is true as long as the Zener diode current remains between the minimum breakdown current $I_{Z(min)}$ and the maximum current $I_{Z(max)}$.

This ability can be used to regulate a voltage source against supply voltage changes.

The fact that the voltage across the diode in the breakdown region is almost constant is an important application of the Zener diode as a (voltage regulator).



The Zener Diode Regulator circuit



For the circuit, the resistor R_S is connected in series with the Zener diode to limit the current flow. The stabilized output voltage V_{out} is taken from across the Zener diode. The Zener diode is connected such that its - terminal is connected to the positive terminal of the DC supply, so it is reverse biased.

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 regulation of the voltage is active, where the Zener current must stay above this value. The supply voltage V_S must be greater than V_Z.

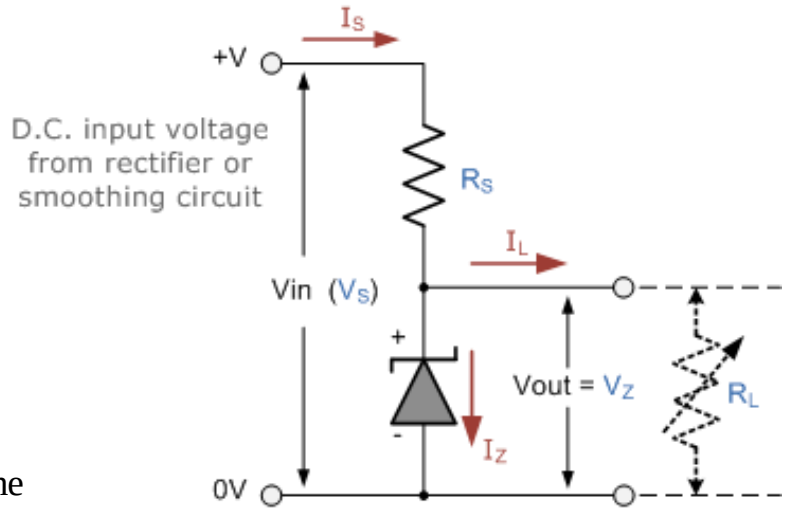
A Zener diode is always operated in its reverse biased mode. A voltage regulator circuit can be designed using a Zener diode, and it is used to maintain a constant DC output voltage across the load, which is done in spite of changes in the input voltage, or changes in the load current. The Zener voltage regulator consists of a current limiting resistor R_S connected in series with the input voltage source V_S , and the Zener diode is connected in parallel with the load R_L in this reverse biased condition. The stabilized output voltage is always the same as the breakdown voltage V_Z of the diode.

Example on The Zener Diode Regulator

A voltage source of about 5 V is required to be produced from a 12 V DC voltage source. The maximum power rating P_Z of the Zener diode is 2 W. Using the Zener regulator circuit shown previously, calculate:

a). The maximum current flowing through the Zener diode:

$$\text{Maximum Current} = \frac{\text{Watts}}{\text{Voltage}} = \frac{2w}{5v} = 400mA$$



b). The minimum value of the series resistor, R_S

$$R_S = \frac{V_S - V_Z}{I_Z} = \frac{12 - 5}{400mA} = 17.5\Omega$$

c). The load current I_L if a load resistor of 1kΩ is connected across the Zener diode.

$$I_L = \frac{V_Z}{R_L} = \frac{5v}{1000\Omega} = 5mA$$

Notes:

1- The max. current passing through the Zener (I_{zmax}) occur when the load current is zero.

2- The min. value for the series resistance can be calculated when the max. current pass through the Zener.