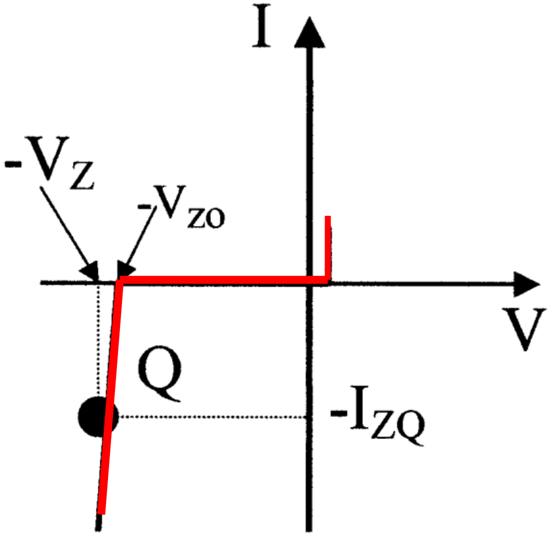
Zener Diode

- The linear approximation to the I-V characteristic of a zener diode in the reverse bias and breakdown regions is as follows.



Zener Diode

- The slope of the line at Q is $1/r_Z$
- r_Z is called the incremental resistance of the zener diode
- This is exaggerated for clarity in the figure. In practice r_Z is small (a few ohms) and the breakdown voltage is approximately constant irrespective of the reverse current.

Zener Diode

- Zener breakdown occurs when the electric field in the depletion layer increases to the point where it can break covalent bonds and generate electron-hole pairs.
- Electrons generated in this way are swept by the electric field into the n side.
- Holes generated in this way are swept by the electric field into the p side.

Zener Current

- These electrons and holes constitute a reverse current through the junction.
- Once the zener effect starts a large number of carriers can be generated with negligible increase in the junction voltage.
- In the breakdown region the reverse current is thus determined by the external circuit,the reverse voltage across the diode remains close to the rated breakdown voltage.

Zener Diode

- The other breakdown mechanism is avalanche breakdown.
- This occurs when minority carrier in the depletion layer gain sufficient kinetic energy to break covalent bonds in atoms when they collide.

Zener Diode

- Avalanche breakdown.
- Carriers liberated may have or gain sufficient energy to cause other carriers to be generated.
- This process continues in the fashion of an ‘avalanche’
- Many carriers can be created to support any reverse current determined by the external current.

Zener Diode

- The device is operated in reverse bias.
- Thus we reverse the sign notation that we normally use for diode voltages and currents, as shown on the next slide

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