



Avalanche Breakdown and Snubber Circuits in Power Diodes

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Description

Avalanche breakdown

Power diodes are used in various electrical applications, such as rectifiers, inverters, and switching circuits, to convert AC to DC or DC to AC. A power diode is a two-terminal device that conducts current in one direction and blocks the current in the opposite direction. When a reverse voltage is applied to the power diode, it behaves as an open circuit until the reverse voltage exceeds a certain threshold value, known as the breakdown voltage. At the breakdown voltage, the power diode conducts heavily in the reverse direction, and high current flows through the diode.

Avalanche breakdown is a type of breakdown mechanism that occurs in power diodes. It occurs when the reverse voltage applied to the power diode exceeds its breakdown voltage. The avalanche breakdown is characterized by the generation of electron-hole pairs due to the high electric field strength. The generated electrons and holes accelerate under the influence of the electric field and collide with other atoms, generating more electron-hole pairs. This process continues, leading to a rapid increase in the number of charge carriers and a high current flow through the diode.

Avalanche breakdown can cause thermal instability and damage to the power diode. Therefore, it is important to limit the energy dissipated during the avalanche breakdown. This can be achieved by using snubber circuits.

Snubber circuits

A snubber circuit is an electronic circuit used to protect power diodes from voltage transients, such as spikes and surges. It is a combination of a capacitor and a resistor connected in parallel with the power diode. The capacitor is used to absorb the energy of the voltage transient, while the resistor limits the current flowing through the capacitor.

In power diodes, snubber circuits are used to limit the energy dissipated during the avalanche breakdown. When the avalanche breakdown occurs, the high current flowing through the diode generates a large amount of energy, which can damage the diode. The snubber circuit helps to limit this energy by providing a path for the excess energy to dissipate.

The snubber circuit works by absorbing the excess energy generated during the avalanche breakdown and dissipating it as heat. The capacitor in the snubber circuit absorbs the energy by charging up to the peak voltage of the transient. The resistor limits the current flowing through the capacitor and dissipates the energy as heat.

The value of the snubber circuit components, such as the capacitance and resistance, depends on the characteristics of the power diode and the voltage transient. A high capacitance and low resistance value will provide better protection against voltage transients, but it can also slow down the switching speed of the power diode.

Conclusion

In conclusion, the avalanche breakdown is a mechanism that can cause damage to power diodes, and snubber circuits are used to limit the energy dissipated during the avalanche breakdown. The snubber circuit helps to protect the power diode from voltage transients, such as spikes and surges, and improve the reliability and longevity of the power diode.

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