Metal Oxide Varistor：Introduction

Introduction

Metal Oxide Varistor (MOV) is also known as Varistors that stands for variable resistors. It is a voltage-dependent resistor (also known as VDR) with bidirectional and symmetrical V/I characteristics (Fig.1).

Varistor is polycrystalline ceramic devices exhibiting highly nonlinear electrical behavior and greater energy absorption capability. The fabrication of varistor is done by mixing semiconducting ZnO powder with other oxide powders, and subjecting the powder mixture to conventional ceramic pressing and sintering. The sintering results in a polycrystalline ceramic with grain-boundary property which produces the nonlinear current-voltage characteristics of the device (Fig. 2).

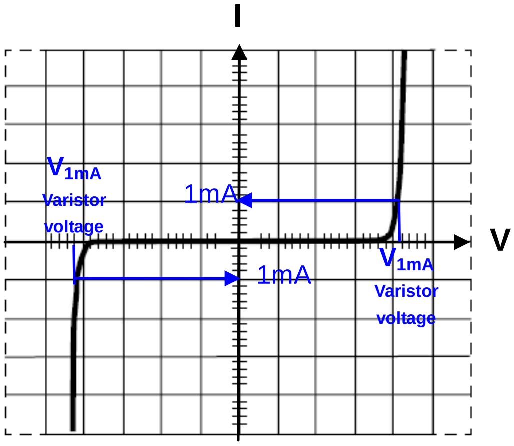

Fig.1 ZnO Varistor V-I characteristics

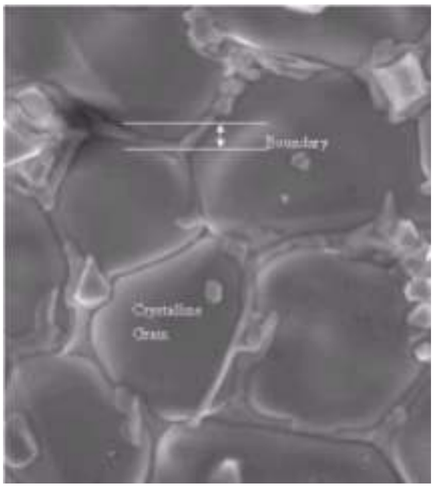

Fig.2 ZnO Varistor SEM micrograph

Varistor is used to protect a circuit from high voltage surges. When a voltage surge exceeds a specified voltage (varistor voltage), the varistor suppresses the voltage to protect the circuit. The varistor electrical characteristics, V-I curve, is normally expressed in Fig.3.

At leakage region, the V-I curve shows like a linear relationship. The varistor is in high resistance mode and shows as an open circuit.

In normal operation, the V-I curve of a varistor can be described by power law:
$I=KV^{\alpha}$

Where K is a constant and α defines the degree of nonlinearity.

At high current, the varistor is in low resistance mode and shows as a short circuit.

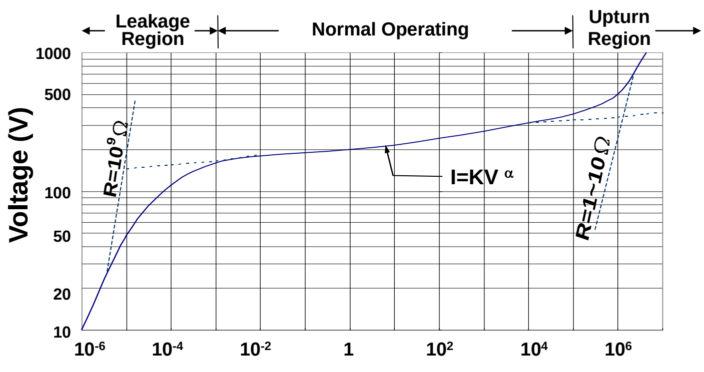

Fig.3 Varistor V-I curve

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Advantages Compared with Other Transient Suppressors:

1. **Better Thermal Properties**

   A silicon suppressor has only one P-N junction to handle the current, but varistor has millions of P-N junctions to offer better energy dissipation capability and peak current handling capability.

2. **Speed of Response**

   The action of varistor is similar to that of other semiconductor devices, and its conduction happens very fast (nanosecond range). In other words, varistor is fast enough to response to any practical requirements.

3. **Stable Clamping Voltage over Temperature**

   Beyond the breakdown point, the clamping voltage of varistor is almost constant over wide range of operating temperature while the clamping voltage of zener diode is higher at upper operation temperature. Even though leakage current of varistor increases following the rise of temperature, its clamping voltage is temperature independent.

4. **Capacitance**

   Compared with zener diodes, varistors have higher capacitance. Depending on the application, transient suppressor capacitance can be a desirable or undesirable feature. In DC circuits, the capacitance of varistors provides both decoupling and transient voltage clamping functions.

5. **Less Expensive**

   Compared with diodes, varistor has small size and is cost-effective.