DID YOU KNOW?

UNDERSTANDING PROTECTION DIODE TERMINOLOGY

Datasheets for protection diodes include terms like *working voltage* and *breakdown voltage,* for which it's useful to know the exact meaning when choosing the best device for your application. Here are definitions for the protection diode terms we're asked about most frequently at Vishay.

Clamping Voltage:

Overvoltage protection diodes are invisible to the application until a transient voltage spike occurs. Until that point, in other words, their leakage current and capacitance have no effect on the performance of the application. Once a transient voltage spike occurs, however, the protection diode needs to start conducting in order to pass the destructive surge current to ground. This prevents the voltage from reaching a critical level for the application. Due to the applied surge power **P**, which is the product of the surge current **I** and the clamping voltage $\mathbf{V_C}$ of the diode ($\mathbf{P = V_C{*}I}$), the diode gets heated and causes the device's avalanche breakdown voltage to rise linearly with the temperature. So the clamping voltage of a protection diode is, in principle, the sum of the temperature-dependent breakdown voltage ($\mathbf{V_{BR}}$ **at** $\mathbf{T_J}$) and the voltage drop across the series resistance $\mathbf{R_S}$ of the diode.

$$V_C = V_{BR}\ (\text{at } T_J) + R_S{*}I$$

Working Voltage:

Also known as stand-off voltage, it's the recommended maximum working voltage range of an application in which a protection diode can be used. If you use the diode at a voltage above this range, you'll increase the device's leakage current (see definition below). However, it's safe to use a diode at lower working voltages than the maximum indicated.

Breakdown Voltage:

The breakdown voltage is the voltage at which an exponential increase of the leakage current happens. Once a device is pushed into avalanche mode, the avalanche current is only limited by the low series resistance of the diode and the source impedance of the applied voltage source.

Leakage Current:

The leakage current of a protection diode is a measure of how many electrons are passing through the depletion zone in the pn-junction, while the applied voltage is below the avalanche breakdown voltage. The total leakage current depends on the temperature of the pn-junction and rises exponentially as temperature increases.

Capacitance:

Capacitance becomes an important parameter for a protection diode in applications where an additional capacitance load can slow down rise and fall times to the point where signal quality is influenced or the data rate is reduced. For example, if the available signal current is limited by a source impedance, e.g. such as **R** = 50 Ω, it needs time to charge or discharge the capacitive load **C** at a signal or data line. Capacitance is thus a critical or non-critical parameter, depending on the application.

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