© 2014 IJIRT | Volume 1 Issue 6 | ISSN : 2349-6002

SCHOTTKY DIODE

Akhil Punia, Ravi Sharma, Pulkit Pahwa
Department of Electrical Engineering, Maharishi Dayanand University

Abstract- ***The Schottky diode also known as hot carrier diode is a Semiconductor diode with a low forward voltage drop and a very fast switching action. The cat's-whisker detectors used in the early days of wireless and metal rectifiers used in early power applications can be considered primitive Schottky diodes.When current flows through a diode thereis a small voltage drop across the diode terminals.A normal silicon diode has a voltage dropsilicon diode has a voltage drop is betweenapproximately 0.15–0.45 volts. This lowervoltage drop can provide higher switchingspeed and better system efficiency***

I. INTRODUCTION

Silicon Schottky diodes are used in power applications because of their low forward voltage drop, which allows lower power loss than ordinary silicon PN junction diodes. These SChottky diodes are used in many applications because they offer a number of advantages:

- Low turn-on voltage
- Low junction capacitance

Schottky diodes high current density and low forward voltage drop means less wasted power compared with ordinary PN junction diodes. This efficiency increase also allows smaller diode heat sinks and less cooling.The choice of the combination of the metal and semiconductor determines the forward voltage of the diode. Both n- and p-type semiconductors can develop Schottky barriers; the p-type typically has a much lower forward voltage. As the reverse leakage current increases dramatically with lowering the forward voltage, it cannot be too low; the usually employed range is about 0.5–0.7 V and p-type semiconductors are employed only rarely. Titanium silicide and other refractory silicides, which are able to withstand the temperatures needed for source/drain annealing in CMOS processes, usually have too low forward voltage to be useful; processes using these silicides therefore usually do not offer Schottky diodes.With increased doping level of the semiconductor the width of the depletion region drops. Below certain width the charge carriers can tunnel through the depletion region. At very high doping levels the junction does not behave as a rectifier anymore and becomes an ohmic contact. This can be used for simultaneous formation of ohmic contacts and diodes, as diodes form between the silicide and lightly doped n-type region and ohmic contacts form between the silicide and a heavily doped n- or p-type region. Lightly doped pose a problem as the resulting contact has too high resistance for a good ohmic contact

II. TYPES OF SCHOTTKY DIODES

There are many different kinds of Schottky diodes and at Future Electronics we stock many of the most common types categorized by maximum average rectified current, maximum reverse voltage, maximum reverse current, forward voltage, packaging type and maximum peak current. The parametric filters on our website can help refine your search results depending on the required specifications
The most common sizes for maximum average rectified current are 70 mA, 100 mA, 200 mA and 1 A. We also carry Schottky diodes with average rectified current as high as 300 A. Forward voltage can range from 280 mV to 430 V, with the most common Schottky diode semiconductor chips having a forward voltage of 800 mV or 1V.

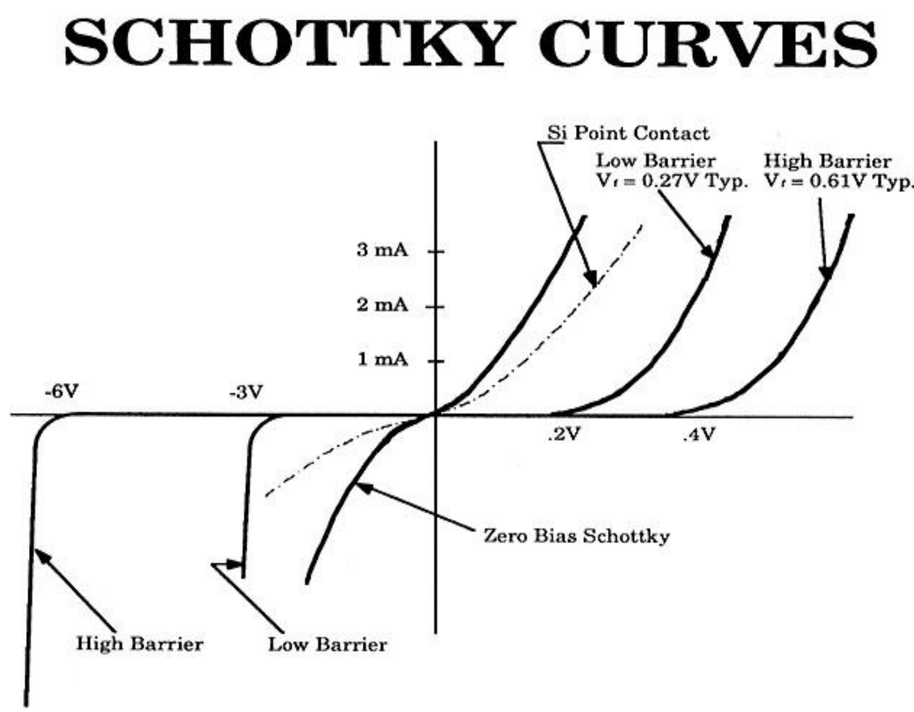
III. REVERSE RECOVERY TIME

The most important difference between the p–n and Schottky diode is reverse recovery time (Trr), when the diode switches from conducting to non-conducting state. Where in a p–n diode the reverse recovery time can be in the order of hundreds of nanoseconds and less than 100 ns for fast diodes, Schottky diodes do not have a recovery time, as there is nothing to recover from (i.e. no charge carrier depletion region at the junction). The switching time is ~100 ps for the small signal diodes, and up to tens of nanoseconds for special high-capacity power diodes. With p–n-junction switching, there is also a reverse recovery current, which in high-power semiconductors brings increased EMI noise. With Schottky diodes, switching is essentially instant with only slight capacitive loading, which is much less of a concern.

This "instant" switching is not always the case. Particularly in higher voltage Schottky devices, The guardring structure needed to control breakdown field geometry presents a parasitic PN diode with the capacitance. If the Schottky junction is driven hard enough however the forward voltage eventually will bias both diodes forward and actual Trr will be greatly impacted This is why Trr numbers are published at very low forward current conditions(like 10 mA on a >1 A diode). The Trr in a real application condition is what matters, and this information is often harder to find. The Schottky diode models distributed by manufacturers are also often given without a Valid TR parameter leading to an optimistic expectation. Only a few subcircuit type models even incorporate the guardring element at all, but most Schottky diodes above 50 V or so use guardrings out of necessity.

IV. LIMITATION

The most evident limitations of Schottky diodes are the relatively low reverse voltage ratings for silicon-metal Schottky diodes, typically 50 V and below, and a relatively highreverse leakage currentSome higher voltage designs are available; 200 V is considered a high reverse voltage. Reverse leakage current, because it increases with temperature, leads to a thermal Instability issue. This often limits the useful reverseVoltage to well below the actual rating.



V. APPLICATIONS

Schottky diodes are useful in voltage clamping applications and prevention of transistor saturation due to the higher current density in the Schottky diode. Also, because of the low forward voltage drop in a Schottky diode, less energy is wasted as heat, therefore making them an efficient choice for applications that are sensitive to efficiency Because of this, they are used in stand-alone photovoltaic systems in order to prevent batteries from discharging through the solar panels at night as well as in grid-connected systems containing multiple strings connected in parallel. Schottky diodes are also used as rectifiers in switched-mode power supplies

VI. RESULT

the Schottky Barrier Diode is used for its low turn-on voltage; fast recover time; and low junction capacitance in applications from power rectification to RF signal applications, and logic.

VII. CONCLUSION

Schottky diodes are used in many applications where other types of diode will not perform as well.

They offer a number of advantages:

Low turn on voltage: The turn on voltage for the diode is between 0.2 and 0.3 volts for a silicon diode against 0.6 to 0.7 volts for a standard silicon diode. This makes it have very much the same turn on voltage as a germanium diode.

Fast recovery time: The fast recovery time because of the small amount of stored charge means that it can be used for high speed switching application

Low junction capacitance: In view of the very small active area, often as a result of using a wire point contact onto the silicon, the capacitance levels are very small.

REFERENCE

INTERNET AND POWER ELECTRONICS BY P S BHIMBRA