Selecting and Designing In The Right Schottky

Summary

International Rectifier offers a broad line of Schottky rectifiers with a variety of packages, rated currents, voltages, and rated junction temperatures. These Schottky rectifiers are intended for use in a variety of power supply applications.

This application note has the following purposes:

- Provide a familiarization with the foundations of IR's Schottky product range by reviewing the different packages, die sizes, and electrical characteristics of the various Schottky processes. Show how these all come together to form an overall product matrix that serves the design needs of virtually any power supply application.
- Review and explain the Schottky data sheet.
- Review the application performance trade-offs between different Schottky types, and give *Guidelines* that steer the user to the best choice of Schottky to meet given application requirements.
- Give design procedures to determine the worst-case design operating point, estimate the losses and select the heatsink for the Schottkys, in the most common power supply circuits.
- Review the techniques for suppressing switching voltage transients and the fundamentals of snubber design.
- Present a comprehensive "Schottky Selection Guide for Power Supplies," which shows, at a glance, the different possible Schottky choices and performance trade-offs for a wide range of different power supply requirements, for the most common power supply circuits.

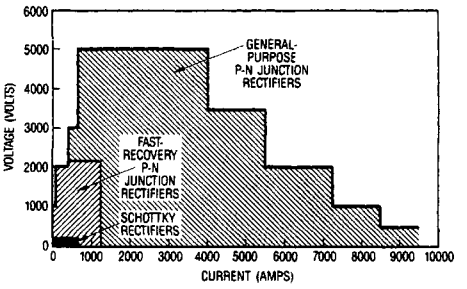

Figure 1. Available ratings of Schottky rectifiers relative to P-N junction rectifiers.

Why a Schottky?

Schottky rectifiers occupy a small corner of the total spectrum of available rectifier voltage and current ratings illustrated in Figure 1. They are, nonetheless, the rectifier of choice for low voltage switching power supply applications, with output voltages up to a few ten of volts, particularly at high switching frequency. For this reason, Schottkys account for a major segment of today's total rectifier usage. This is illustrated in Figure 2.

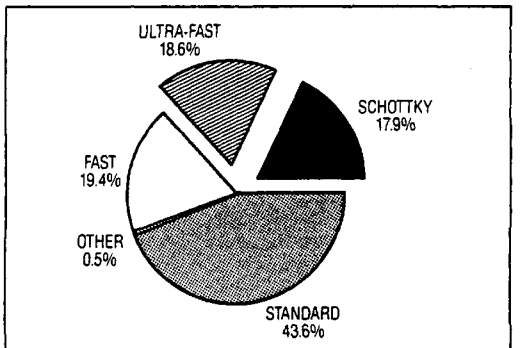

Figure 2. Schottky usage by sales volume relative to total rectifier market. (1989 U.S. Market)

The Schottkys' unique electrical characteristics set them apart from conventional PN junction rectifiers, in the following important respects:

- Lower forward voltage drop
- Lower blocking voltage
- Higher leakage current
- Virtual absence of reverse recovery charge

The two fundamental characteristics of the Schottky that make it a winner over the PN junction rectifier in low voltage switching power supplies are its *lower forward voltage drop,* and virtual *absence of minority carrier reverse recovery.*

The *absence* of minority carrier *reverse recovery* means virtual absence of switching losses within the Schottky itself. Perhaps more significantly, the problem of switching voltage transients and attendant oscillations is less severe for Schottkys than for PN junction rectifiers. Snubbers are therefore smaller and less dissipative.

The *lower forward voltage drop* of the Schottky means lower rectification losses, better efficiency, and smaller heatsinks.

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Forward voltage drop is a function of the Schottky's reverse voltage rating. The maximum voltage rating of today's Schottky rectifiers is about 150V. At this voltage, the Schottky's forward voltage drop is lower than that of a fast recovery epitaxial PN junction rectifier by 150 to 200mV. At lower voltage ratings, the lower forward voltage drop of the Schottky becomes progressively more pronounced, and more of an advantage.

A 45V Schottky, for example, has a forward voltage drop of 0.4 to 0.6V, versus 0.85 to 1.0V for a fast epitaxial PN junction rectifier. A 15V Schottky has a mere 0.3 to 0.4V forward voltage drop.

A conventional fast recovery epitaxial PN junction rectifier, with a forward voltage drop of 0.9V would dissipate about 18% of the output power of a 5V supply. A Schottky, by contrast, reduces rectification losses to the range of 8 to 12%.

These are the simple reasons why Schottkys are virtually always preferred in low voltage high frequency switching power supplies.

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