

# **Frequency Performance of Diamond Schottky Barrier Diodes**

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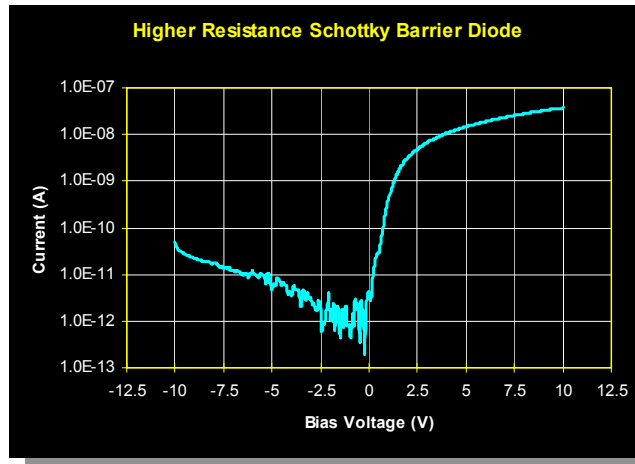
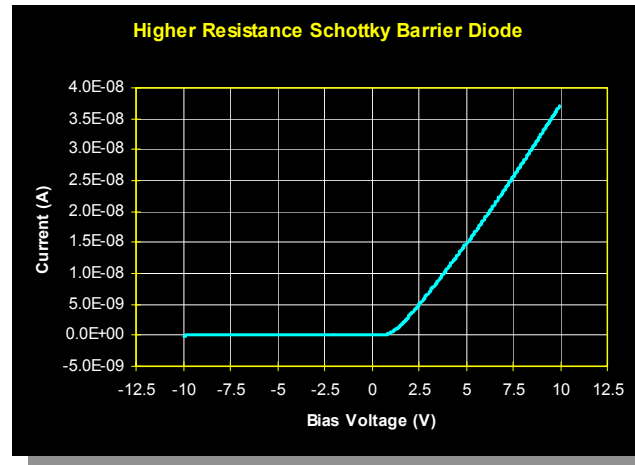
# Introduction

- ◆ Large signal (sinewave and pulse) and small signal response of diamond Schottky diodes have been studied as a function of frequency.
- ◆ Experimental results are compared to computer simulations which include as model inputs the bulk series resistance and capacitance, the diode saturation current and quality factor, the transit-time, and the space-charge layer capacitance.

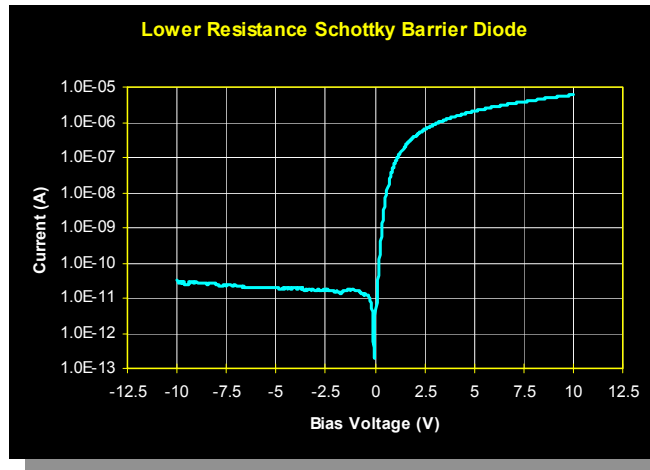
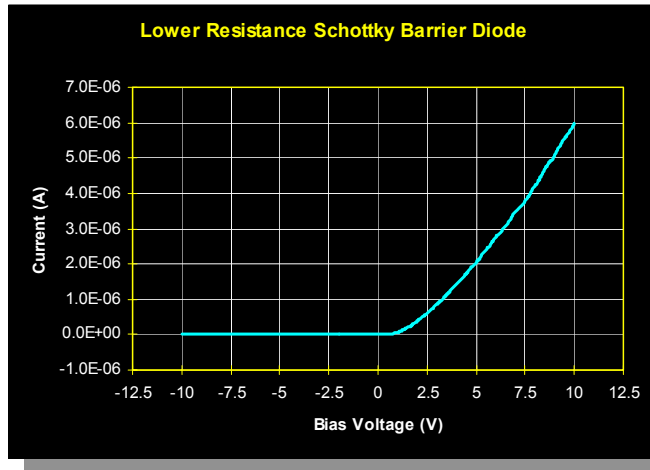
# Methods

- ◆ Aluminum (Schottky) and titanium/gold (ohmic) contacts are made on polycrystalline diamond films deposited on silicon by microwave plasma-assisted deposition. The silicon back contact also serves as an ohmic contact.
- ◆ Sample electrodes were contacted by coaxial probes on a micro-probing station.
- ◆ An Hewlett-Packard 4145B semiconductor parameter analyzer was used for the dc measurements.

- ◆ An Hewlett-Packard 4192A impedance analyzer and an Hewlett-Packard 4284A precision LCR meter were used to measure the small signal impedance versus bias and frequency.
- ◆ Hewlett-Packard 8116A Function Generator, Hewlett-Packard 54200D and Tektronix 11401 Digitizing Oscilloscopes were use to investigate the large signal switching response of the diode

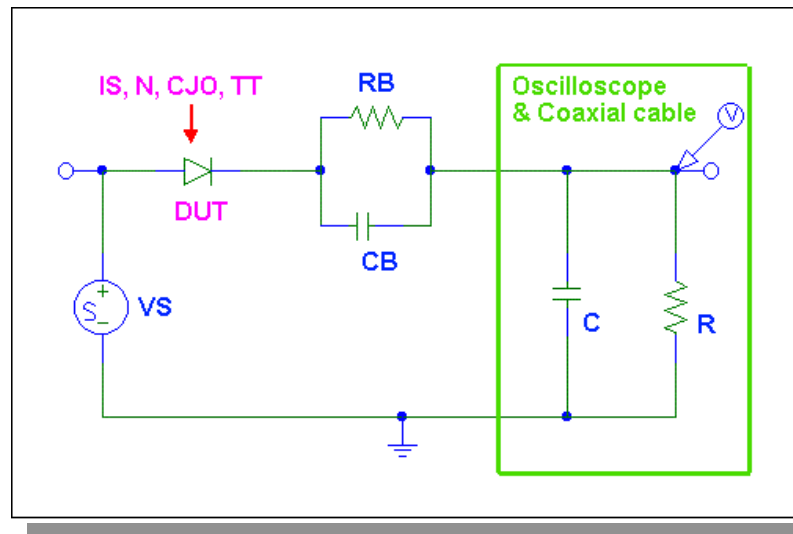


## Higher Resistance Diamond Schottky Diode DC Characteristics



## Lower Resistance Diamond Schottky Diode DC Characteristics

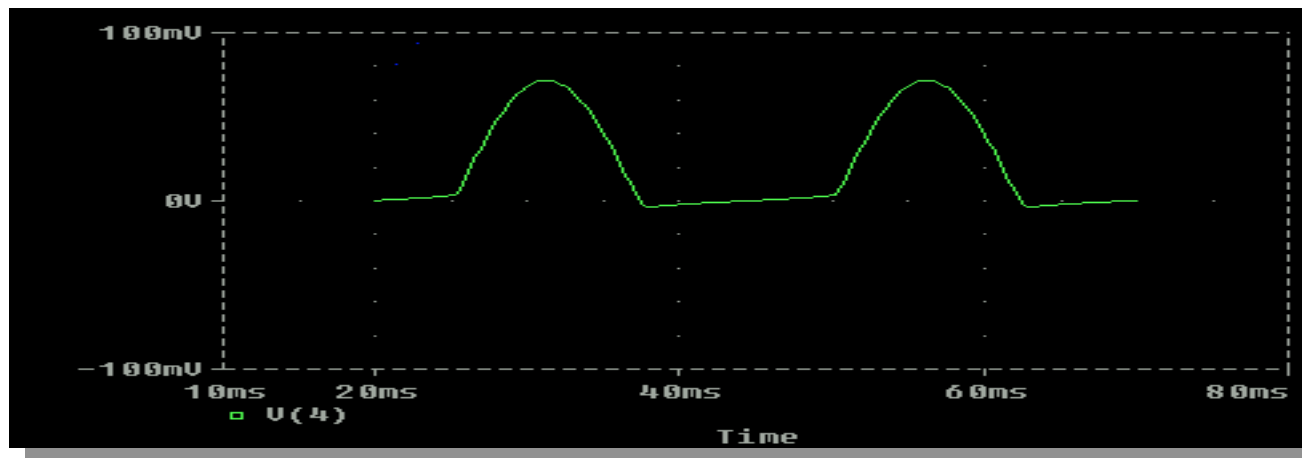
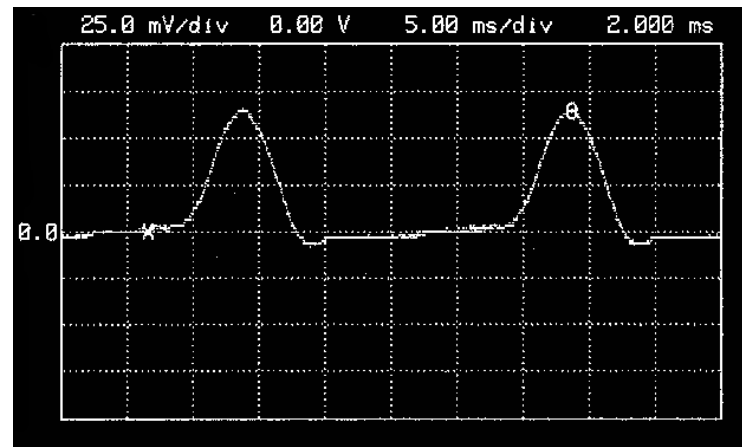
# Diamond Schottky Diode Circuit Model



SPICE parameters Saturation Current ( $I_S$ ), Emission Coefficient ( $N$ ), and Bulk Resistance ( $R_B$ ) are obtained from dc measurement and curve-fitting, Zero-bias Capacitance ( $C_{JO}$ ), Transit Time ( $T_T$ ), and Bulk Capacitance ( $C_B$ ) are added for ac modeling.

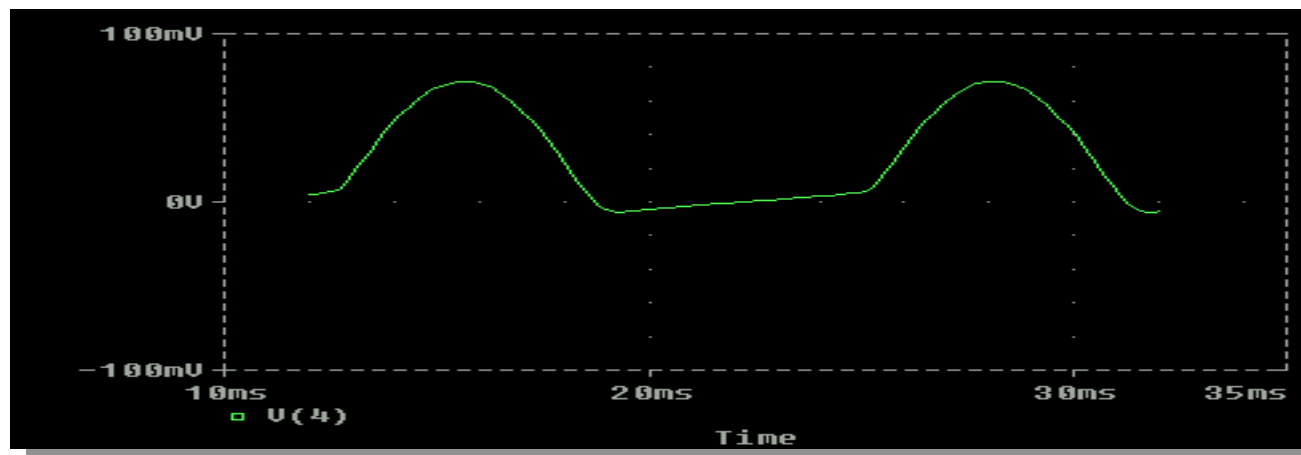
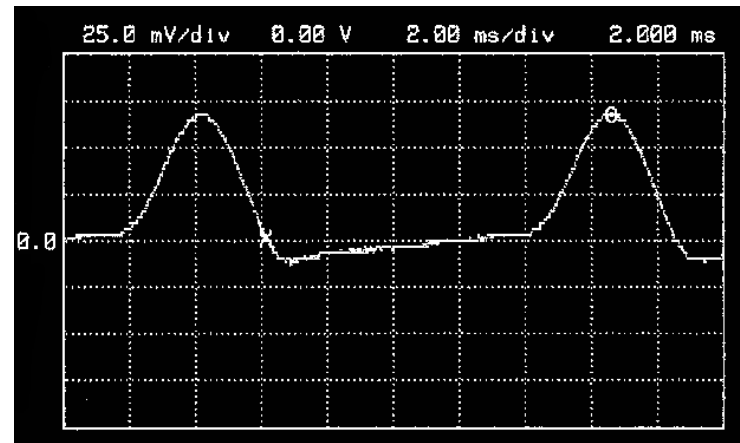
# Higher Resistance Schottky Diode Rectification at 40 Hz

Experimental(top) and SPICE Simulation (bottom) results.



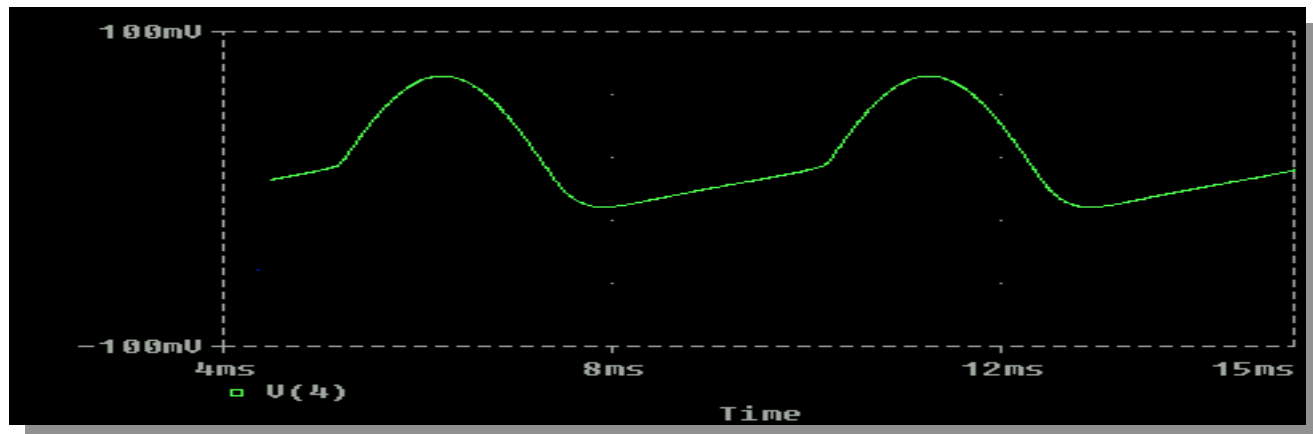
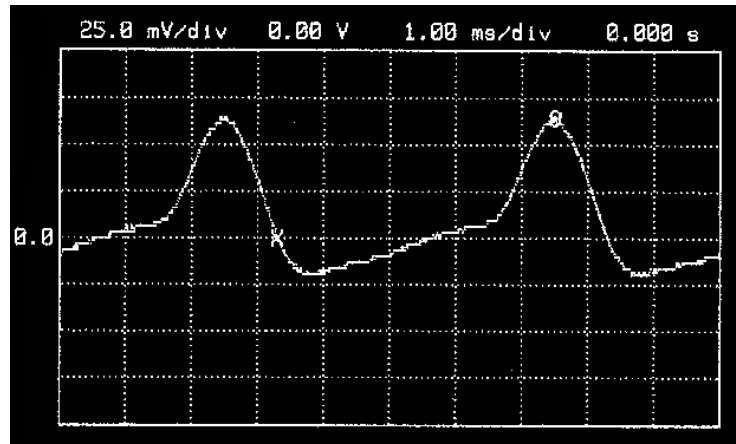
# Higher Resistance Schottky Diode Rectification at 80 Hz

Experimental(top) and SPICE Simulation (bottom) results.



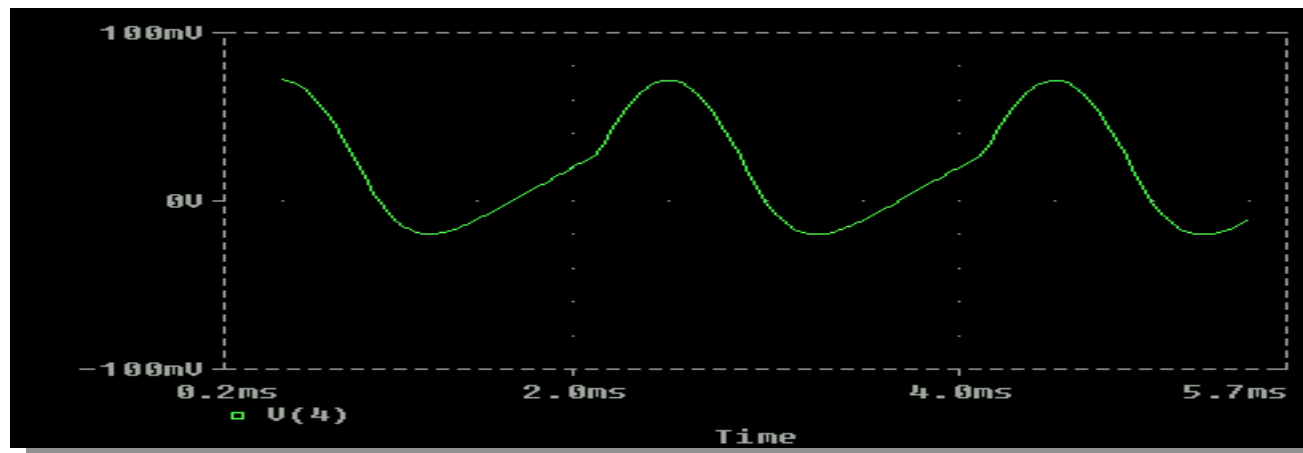
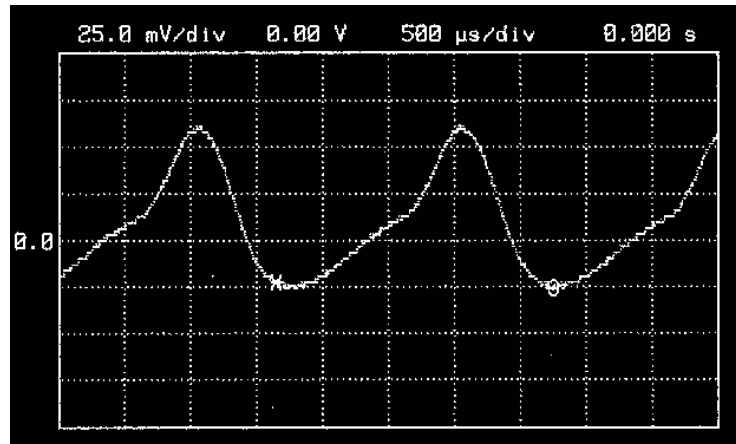
# Higher Resistance Schottky Diode Rectification at 200 Hz

Experimental(top) and Simulation (bottom) results show slow speed response due to high dynamic resistance.



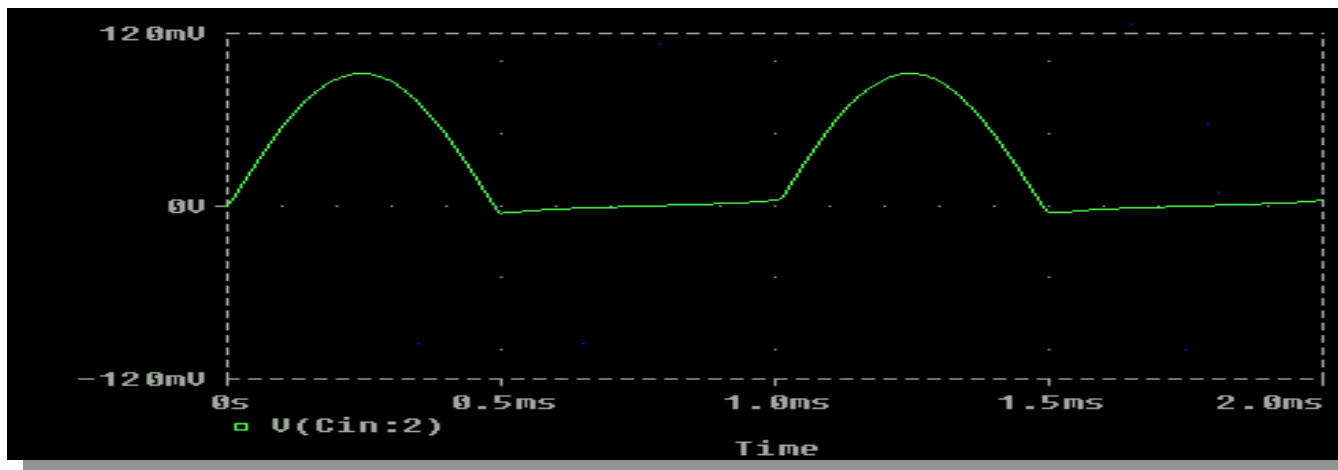
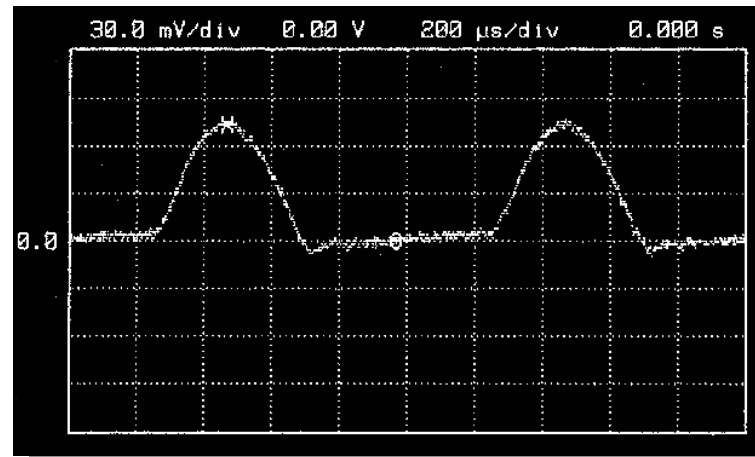
# Higher Resistance Schottky Diode Rectification at 500 Hz

Experimental(top) and Simulation (bottom) results show slow speed response due to high dynamic resistance.



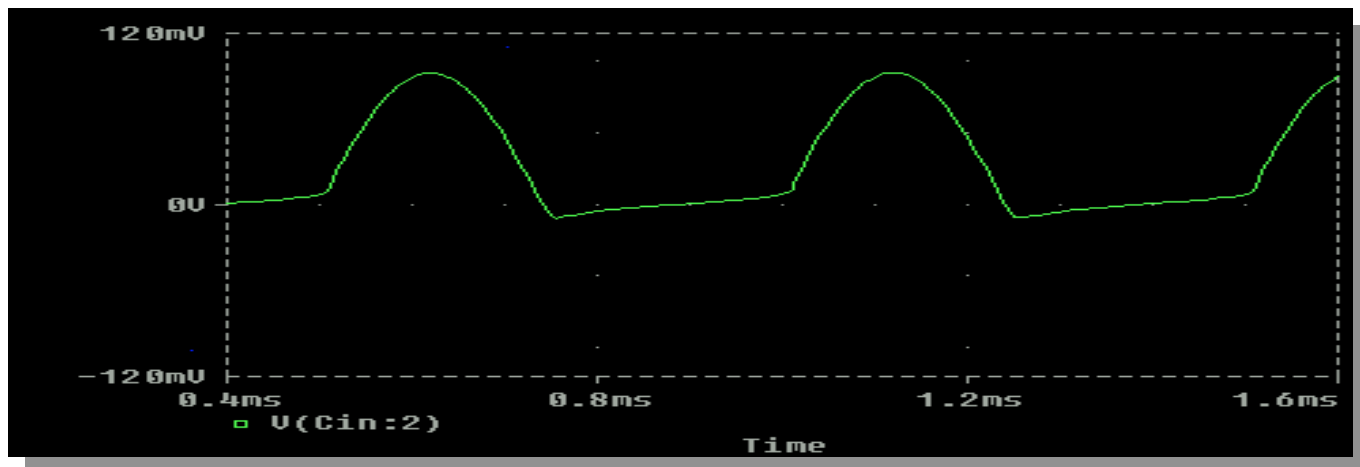
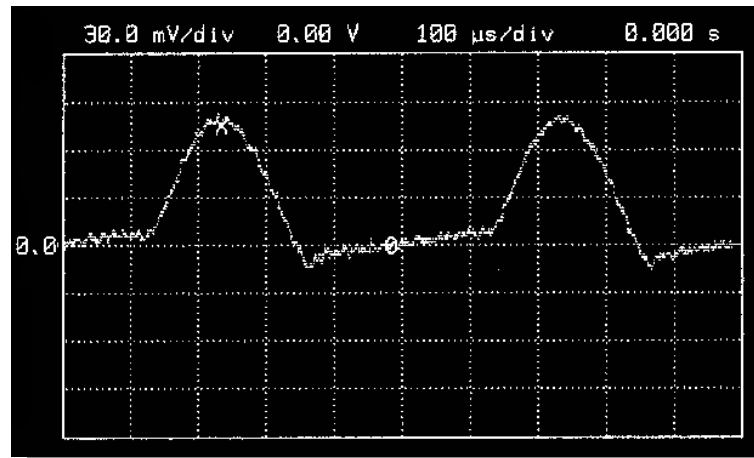
# Lower Resistance Schottky Diode Rectification at 1 KHz

Experimental(top) and Simulation (bottom) results both show speed improvement in the lower resistance diode.



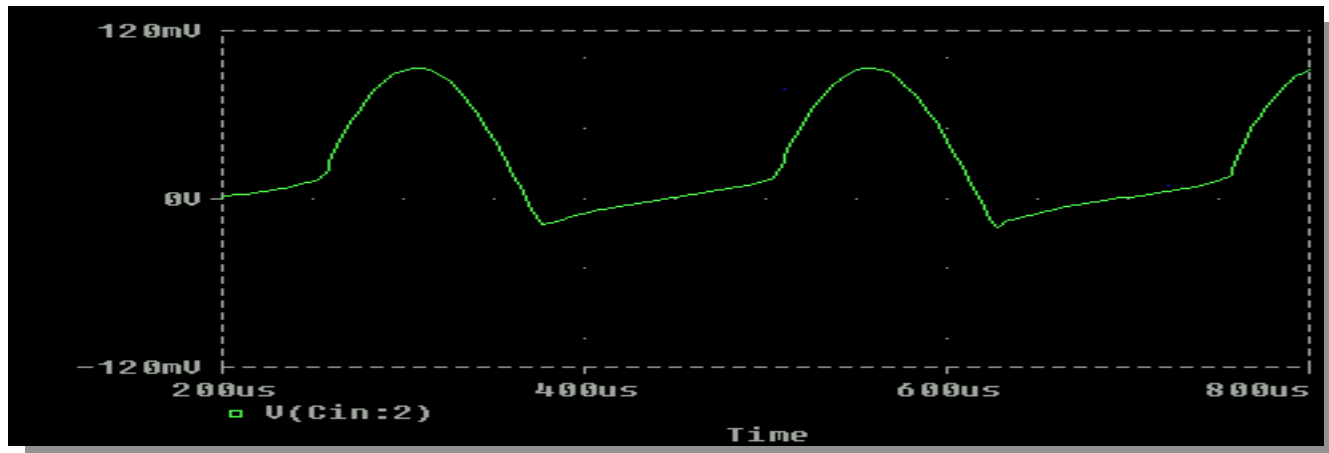
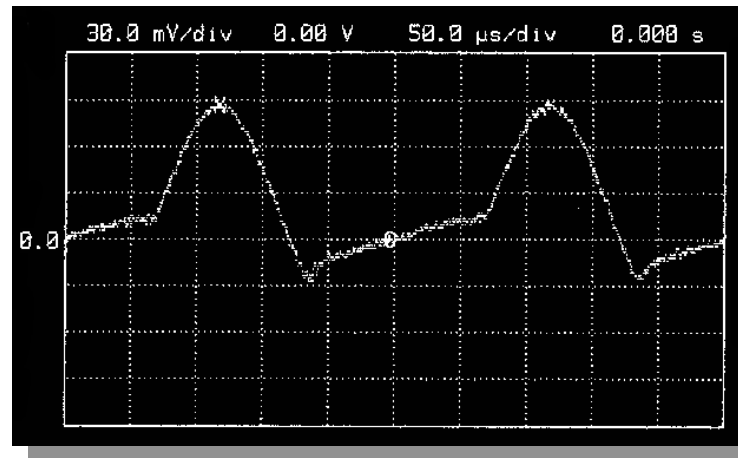
# Lower Resistance Schottky Diode Rectification at 2 KHz

Experimental(top) and Simulation (bottom) results.



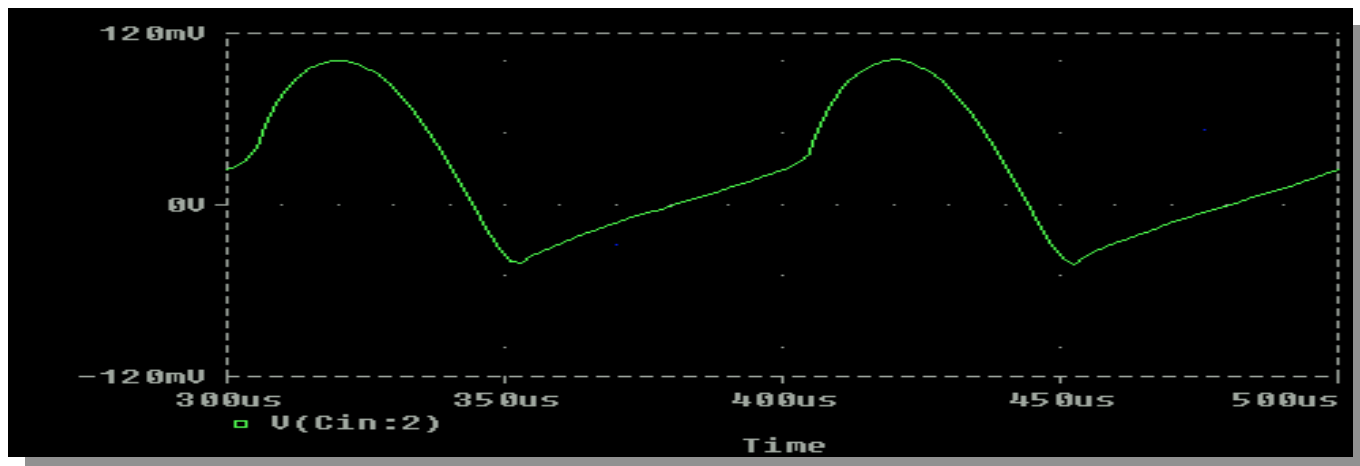
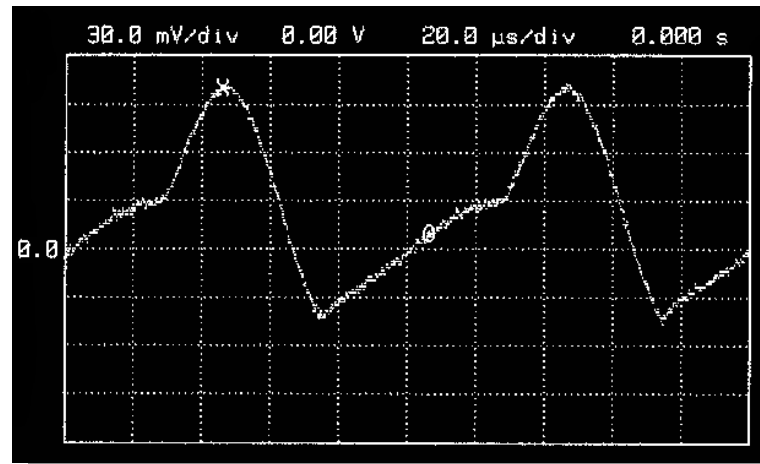
# Lower Resistance Schottky Diode Rectification at 4 KHz

Experimental(top) and Simulation (bottom) results.



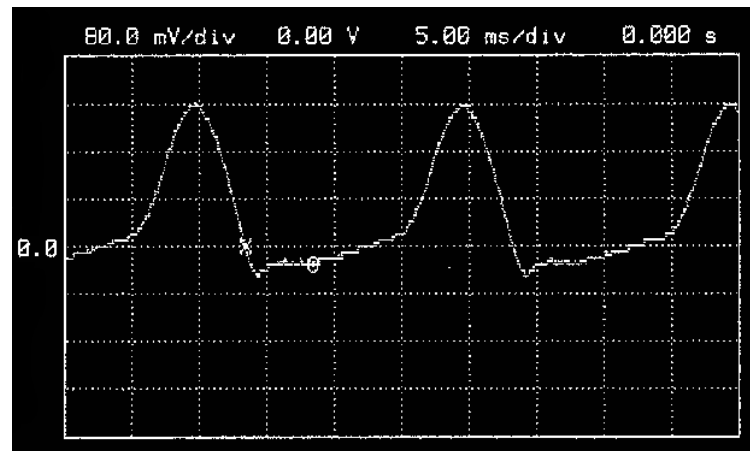
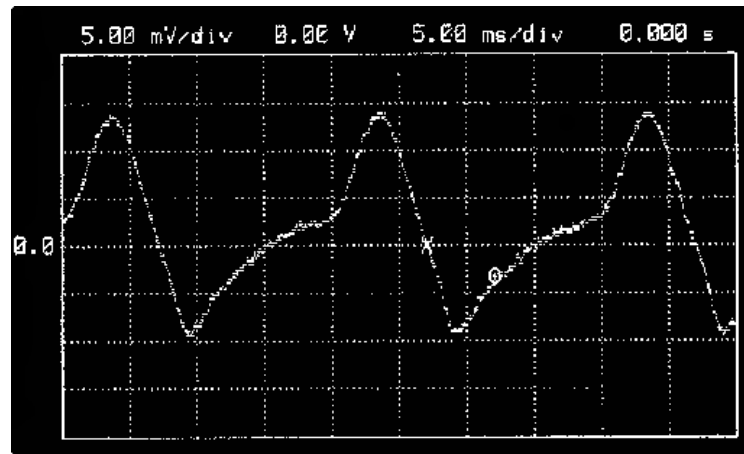
# Lower Resistance Schottky Diode Rectification at 10 KHz

Experimental(top) and Simulation (bottom) results.



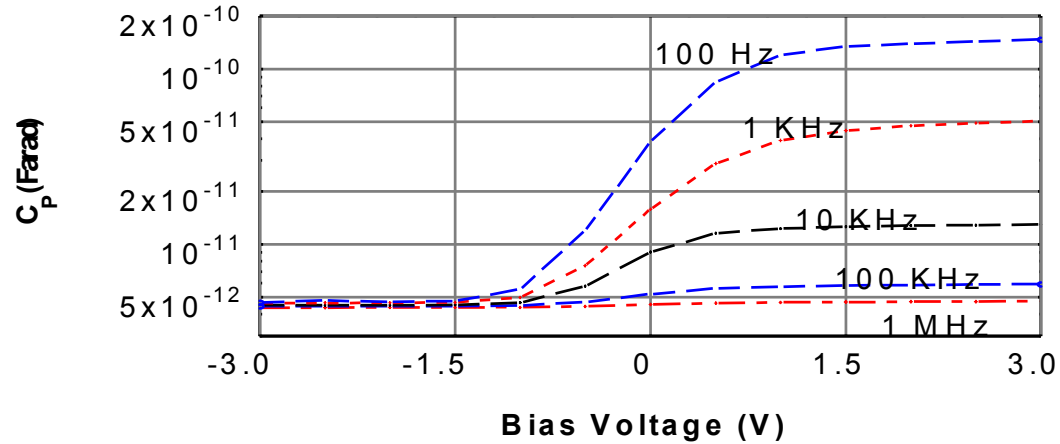
# Temperature Effect on Schottky Diode Rectification

Experimental results at 300 K (top) and 400 K (bottom) on high resistance diode show rectification improvement at higher temperature.



# Small Signal Response of Diamond Schottky Diode

## Small Signal Capacitance versus Bias voltage



## Small Signal Resistance versus Bias voltage

