

PIN Diode IV Characteristics, Transient Analysis & Application

Electronic Devices and Characterization Experiment 2

Department of Electrical Engineering
Indian Institute of Technology, Bombay

Background Theory

- PIN diode has a wide, un-doped intrinsic semiconductor region between 'P' and 'N' regions. The P-type and N-type regions are typically heavily doped.



- PIN diode obeys the standard diode equation for low-frequency signals. At higher frequencies, the diode looks like an almost perfect resistor.
- Under zero- or reverse-bias, a PIN diode has a low capacitance. The low capacitance will not pass much of an RF signal. Under a forward bias, a PIN diode will have a low RF resistance, making it a good conductor of RF. Consequently, the PIN diode makes a good RF switch.

Aim of the experiment

- To find forward voltage, reverse saturation current and ideality factor of the given PIN diode (Infineon BAR 15-1) and compare with normal PN junction Diode (1N4007).
- To find reverse recovery time of the given PIN diode at various frequencies and compare with the reverse recovery time of normal PN junction Diode.
- To observe how the PIN diode works as an RF switch at different DC bias voltages.

Components required

- PIN diode Infineon BAR 15-1, PN junction diode 1N4007.
- Resistors - 500Ω ($\times 2$), 50Ω , $1k\Omega$
- Potentiometer - $1k\Omega$
- Capacitors - $100nF$ ($\times 2$)
- Breadboard, connecting wires
- Multi-meters, variable power supply, signal generator and oscilloscope

Experiment-Part 1

- 1 Make the connections as per the circuit diagram. Notice the role of the $1k\Omega$ pot, that can be used to vary the voltage to be applied to the diode.
- 2 Vary V_D in suitably small steps (from 0 V to 1 V only), and measure and tabulate I_D and V_D for each step.

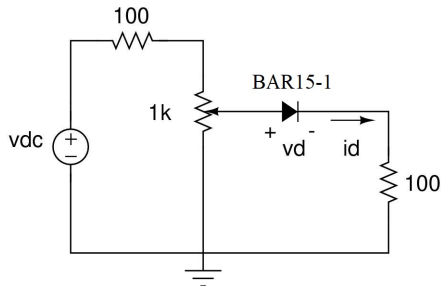


Figure: Circuit to measure I/V characteristics of a semiconductor diode

You are advised to simultaneously plot I-V in the lab, to quickly identify if the measurement is as expected.

Experiment-Part 2

Apply square wave of different frequencies (10 *KHz*, 100 *kHz*, 1 *MHz*, 3 *MHz*) to the given circuit (for both PIN diode and PN diode) and note down the reverse recovery times.

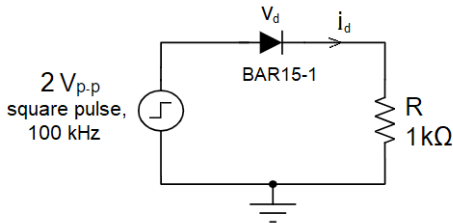


Figure: Circuit to measure reverse recovery time

Which diode has the potential of passing major portion of the input signal to the output at 3 *MHz*?

Experiment-Part 3

Make the circuit as shown and find sinusoidal output voltage and diode DC current for different DC bias voltages (-5 V , 0 V , 1 V , 3 V , 5 V).

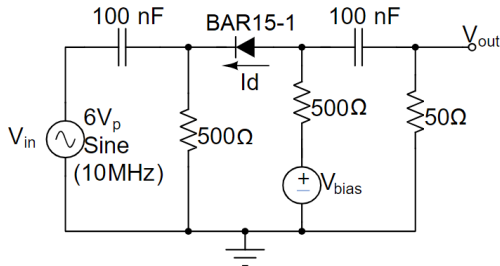
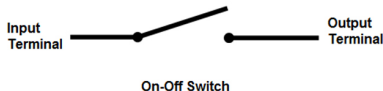


Figure: Circuit to characterize PIN diode as RF switch

Repeat the experiment using regular PN junction diode and note down the results. Relate the PIN diode circuit with an SPST switch.



Documenting Results

Table format for reverse recovery time comparison (part 2).

Frequency	RRT of PIN	RRT of PN
10 kHz		
100 kHz		
1 MHz		
3 MHz		

Table format for RF switch (part 3).

V_{bias}	I_D	V_{out}
-5V		
0V		
1V		
3V		
5V		

BAR15-1 Device

The Infineon BAR15-1 PIN Diode has a common cathode structure.

