EE236 : Electronic Devices Lab
Lab 2 [Tuesday Batch]

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1 Aim

To find the forward voltage, reverse saturation current and ideality factor, the reverse recovery time of the given PIN diode at various frequencies and compare it with a regular PN diode and to show its working as an RF switch.

2 Prelab simulations

2.1 Code for IV characterisitics

```
IV Characteristics of PIN Diode
.includern142 .txt
vs 1 0 dc 0
vy 2 3 dc 0
da 1 2 DRN142S
ra 3 0 100
.dc vs 0.0015 0.01
.control
run
plot i(vy) vs {v(1)     v(2)}
plot ln(i(vy)) vs {v(1)     v(2)}
.endc
.end
```

2.2 Code for reverse recovery time

```
Reverse Recovery Current
.include rn142.txt
v1k 1 0 pulse(  1101ns   1ns 0.5ms 1ms 0 )
d1 1 4 DRN142S
vt 4 5 0 dc
```

```
 6 r a 5 0 100
 7 .tran 0.3ns 285.2us 284.8us
 8 .control
 9 run
10 plot i(vt)
11 .endc
12 .end
```

2.3   Code for RF Switch

```
 1 RF Switch
 2 .include rn142.txt
 3 d1 1 7 DRN142S
 4 vdi ode 7 2 dc 0
 5 c1 2 3 100n
 6 r 1 2 0 500
 7 r 2 1 4 500
 8 voutput 5 6 dc 0
 9 r 3 6 0 50
10 c2 5 1 100n
11 vbias 0 4 dc 5
12 vin 3 0 sin( 0 3 10MEG 0 0 0 )
13 .tran 0.1ns 2us 1us
14 .control
15 run
16 plot v(5)
17 plot i(voutput) i(vdiode)
18 .endc
19 .end
```
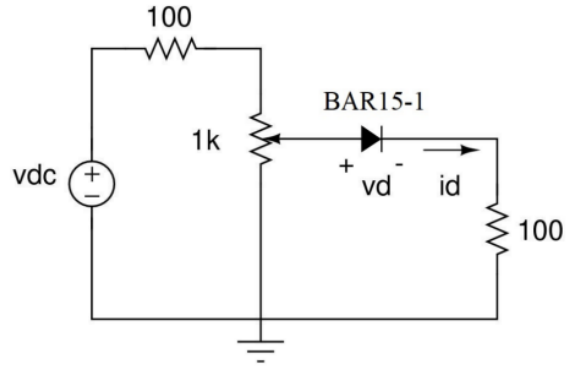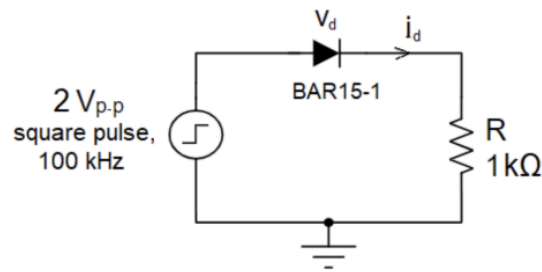
3   Circuits

Figure 1: IV characterisitics

Figure 2: Recovery Time

4   Observations:

4.1   I-V Characterisitics

The I-V characteristics were plotted for the PIN diode by varying the current and voltage by adjusting a 1k potentiometer and taking the following readings:
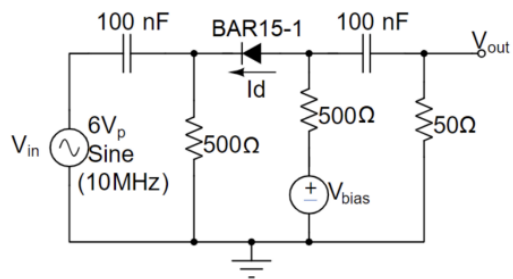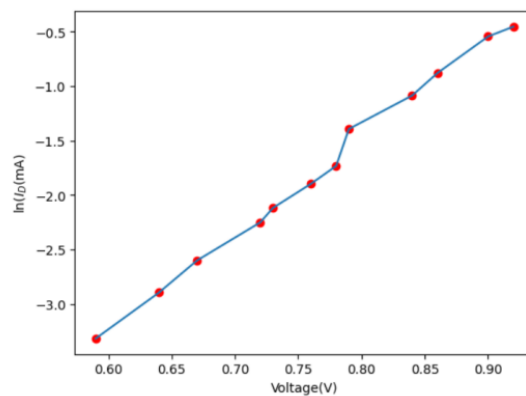
Figure 3: RF Switch behaviour

V_D	I_D
0.220	0.00
0.230	0.01
0.250	0.01
0.300	0.30
0.450	0.85
0.400	2.30
0.450	6.20
0.500	13.8
0.550	36.4
0.600	98.0
0.650	245.0
0.700	630.0
0.750	1623
0.800	4320
0.850	10400
0.886	18130
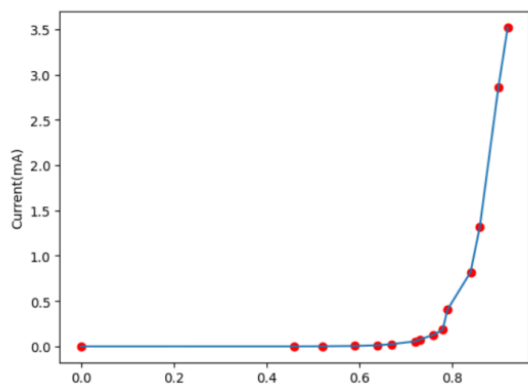
Frequency (kHz)	Recovery Time (PN)	Recovery Time (PIN)
10	5.52 μs	4.02 μs
100	3.14 μs	2.92 μs
1000	450 ns	343 ns
3000	170 ns	161 ns

4.2 Reverse Recovery time

Thus, we notice that, at 3 MHz, the PIN diode has the potential of passing a major portion of the input signal to the output compared to the PN diode. This is because the PIN diode has a faster recovery time (in the range of nanoseconds) due to the intrinsic layer, which allows it to handle higher frequencies more efficiently. On the other hand, the PN diode has a slower recovery time, making it less effective at passing high-frequency signals like those at 3 MHz.

4.3 Characterizing PIN Diode as RF Switch

4.3.1 For PIN Diode

V_D	I_D	V_out
-5	0	8
0	1.1	60
1	1.5	64.5
3	1.84	69.5
5	4.2	71.8

4.3.2 For PN Diode

V_D	I_D	V_out
-5	0	13
0	1.15	61
1	1.45	61
3	1.34	61
5	4.32	69

5 Conclusion

The forward voltage, reverse saturation current, and ideality factor were determined. Reverse recovery times were measured at different frequencies for comparison between the PIN and PN junction diodes. The PIN diode's performance as an RF switch was successfully demonstrated.

6   Experiment Completion Status

The experiment was completed in the lab hours and the values and plots obtained for the various diodes, the simulation outputs were shown to the TA and were verified. The .xlsx containing all the readings and plots after verification from the TA were uploaded on Moodle during the lab hours