Report of Lab 2:
More on Static and Dynamic Diode Responses Using OrCAD

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1 1st Circuit

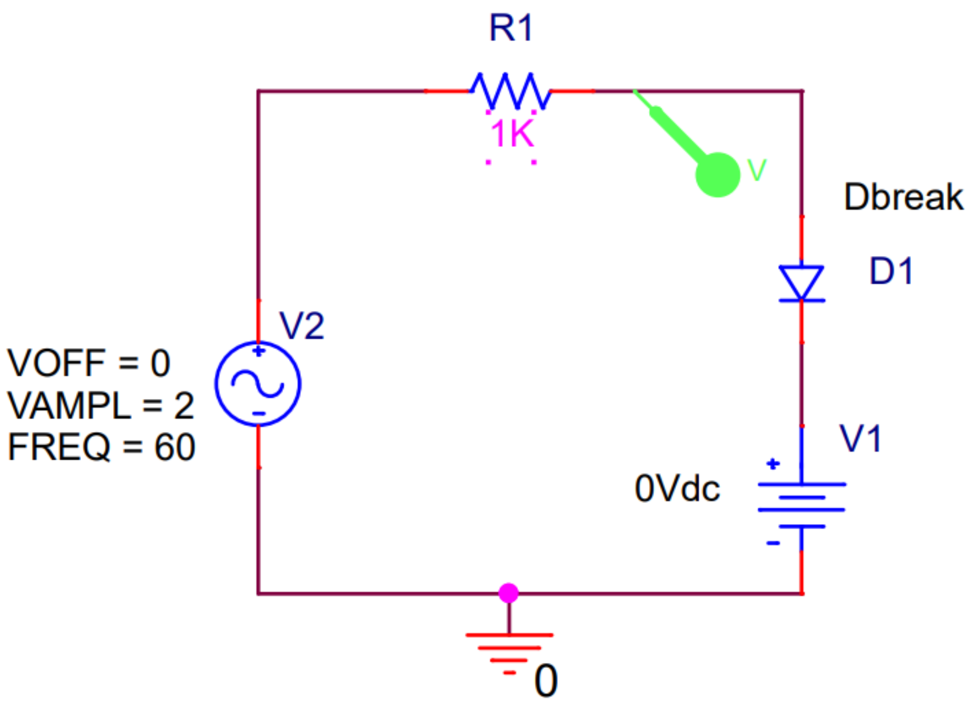
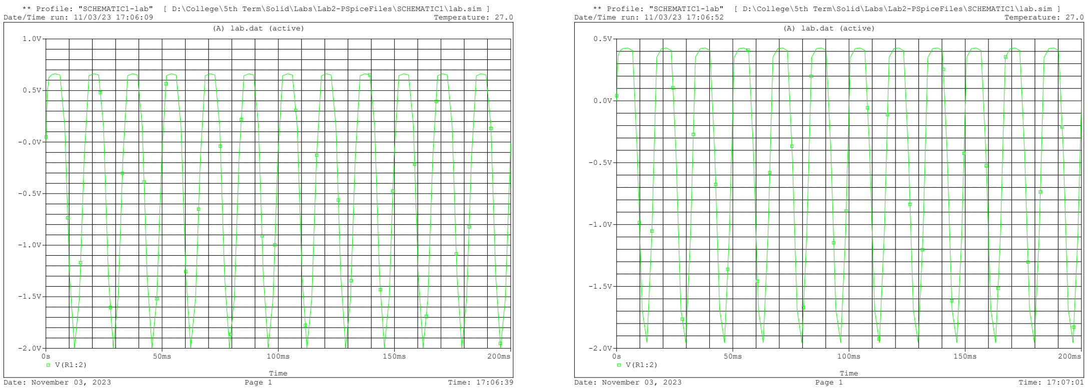


Figure 1: 1st Circuit Simulation

1.1 I_s Change with Time



(a) $I_s = 10^{-14}A$

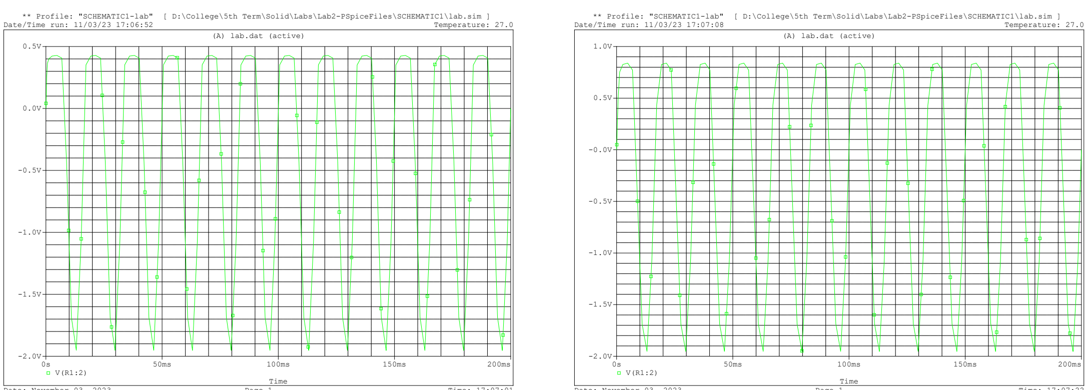
(b) $I_s = 10^{-10}A$

Figure 2: I_s Change with Time Plots

1.1.1 Discussion

Analyze the results obtained we understand that more I_s value gives higher peak to peak voltage amount on the output as relation $V_D = NV_t \ln(\frac{I_d}{I_s} + 1)$ so I_s indirect proportional with V_D.

1.2 N Change with Time



(a) $I_s = 10^{-10}A, N = 1$

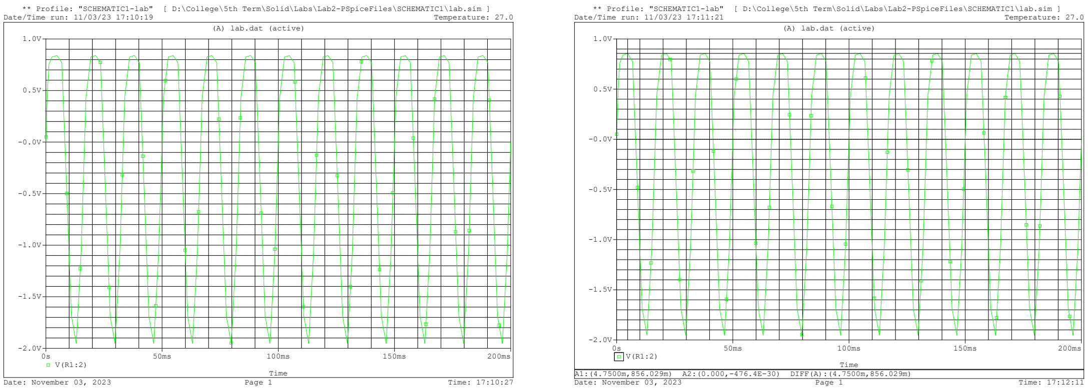
(b) $I_s = 10^{-10}A, N = 2$

Figure 3: N Change with Time Plots

1.2.1 Discussion

Analyze the results obtained we understand that more N value gives lower peak to peak voltage amount on the output as relation $V_D = NV_t \ln(\frac{I_d}{I_s} + 1)$ so N direct proportional with V_D.

1.3 Changing R_s with Time



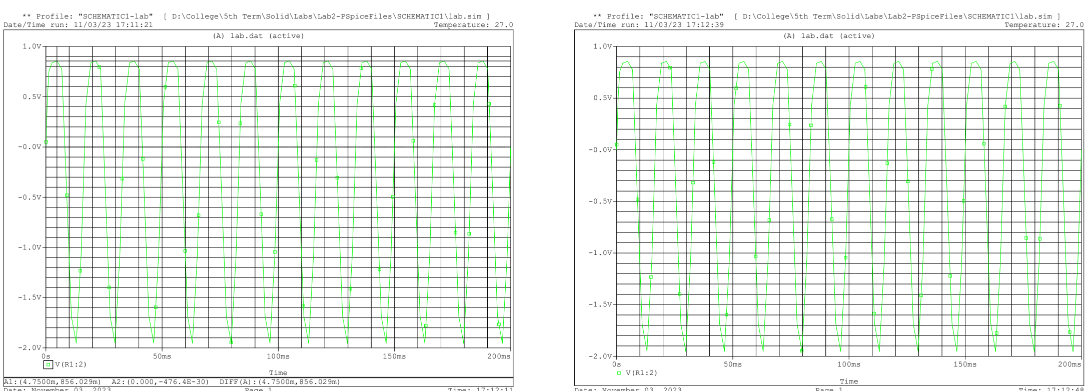
(a) $I_s = 10^{-10}A, N = 2, R_s = 0$ (b) $I_s = 10^{-10}A, N = 2, R_s = 16$

Figure 4: Changing R_s with Time Plots

1.3.1 Discussion

Analyze the results obtained we understand that more R_s value gives higher peak to peak voltage amount on the output as relation $V_D = R_s I_s + NV_t \ln\left(\frac{I_d}{I_s} + 1\right)$ so R_s direct proportional with V_D.

1.4 Changing R with Time



(a) $I_s = 10^{-10}A, N = 2, R_s = 16, R = 1kohms$ (b) $I_s = 10^{-10}A, N = 2, R_s = 16, R = 50ohm$

Figure 5: Changing R with Time Plots

1.4.1 Discussion

Analyze the results obtained we understand that more R the voltage divider gives the resistance more voltage and make the R_s more neglected.

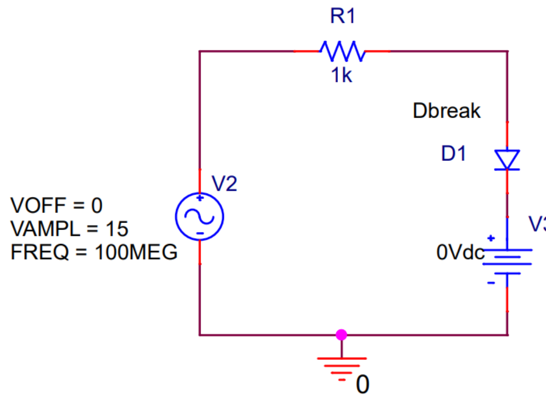
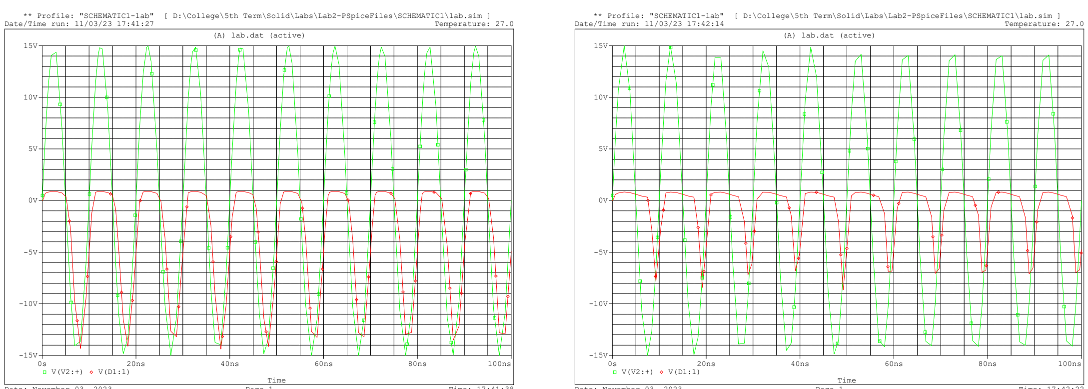


Figure 6: Modification

1.5 Changing TT with Time



(a) $TT = 0$

(b) $TT = 12ns$

$$I_s = 0.1pA, N = 1, R_s = 16, C_{Jo} = 2pF, M = 0.5, V_J = 0.75$$

Figure 7: Changing TT with Time Plots

1.5.1 Discussion

Due to relation $C_s = TT\frac{dI_D}{dV_{D_o}}$ as $C_D = C_d + C_s$ so it gives more output in inverse mode in $TT = 0$ as having more capacitance and fig. b has more oscillations.

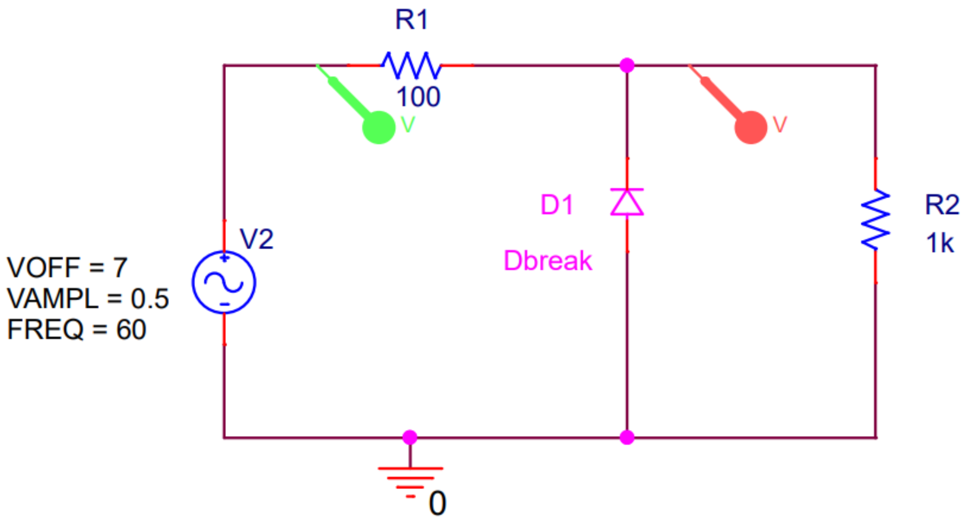
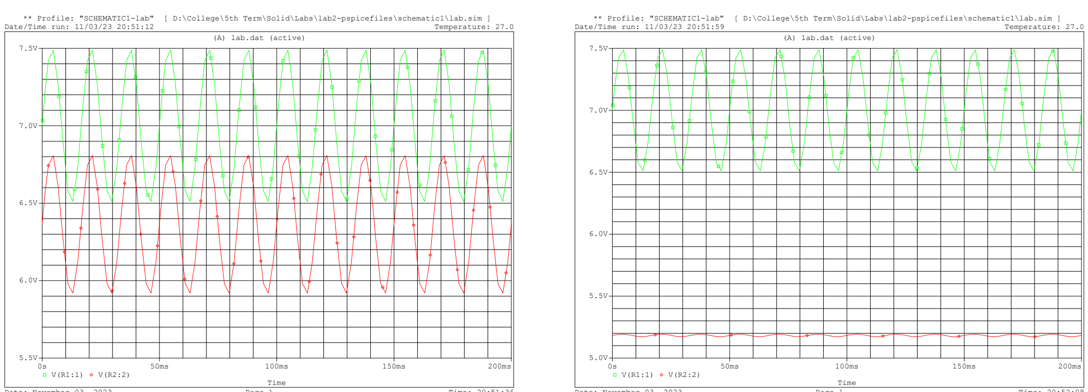


Figure 8: 2^{nd} Circuit Simulation

2 2^{nd} Circuit

2.1 BV Change with Time



(a) $BV = \infty$

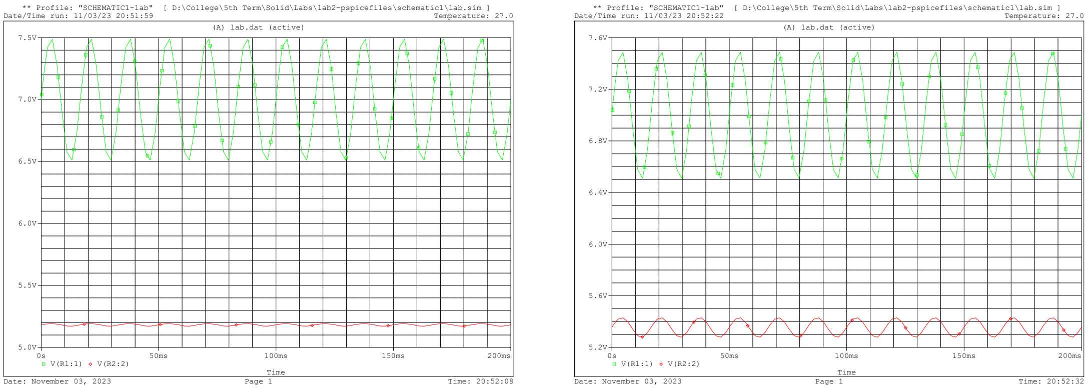
(b) $BV = 4.7$

Figure 9: BV Change with Time Plots

2.1.1 Discussion

Analyze the results obtained we understand that as BV tends to ∞ the peak to peak voltage amount tends to max on the output as relation $I_D = I_s(e^{\frac{BV+V_{D_0}}{V_t}} - 1 + \frac{BV}{V_t})$.

2.2 R_S Change with BV and Time



(a) $R_s = 0$ (b) $R_s = 16$

Figure 10: R_S Change with BV and Time Plots

2.2.1 Discussion

Analyze the results obtained we understand that more R_s value gives higher peak to peak voltage amount on the output as relation $I_D = I_s(e^{\frac{BV+V_{D_0}}{V_t}} - 1 + \frac{BV}{V_t})$.

3 3rd Circuit

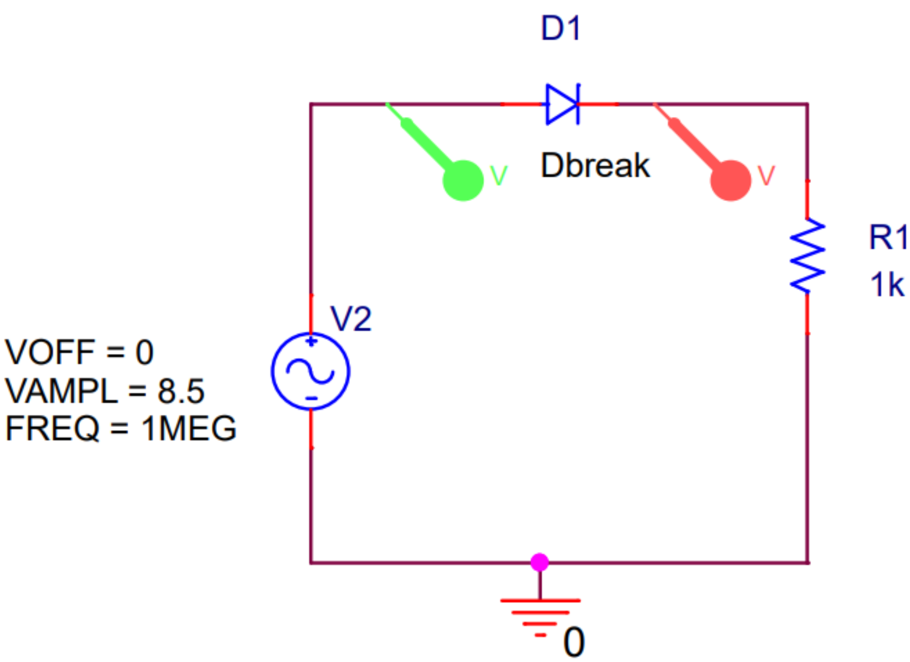
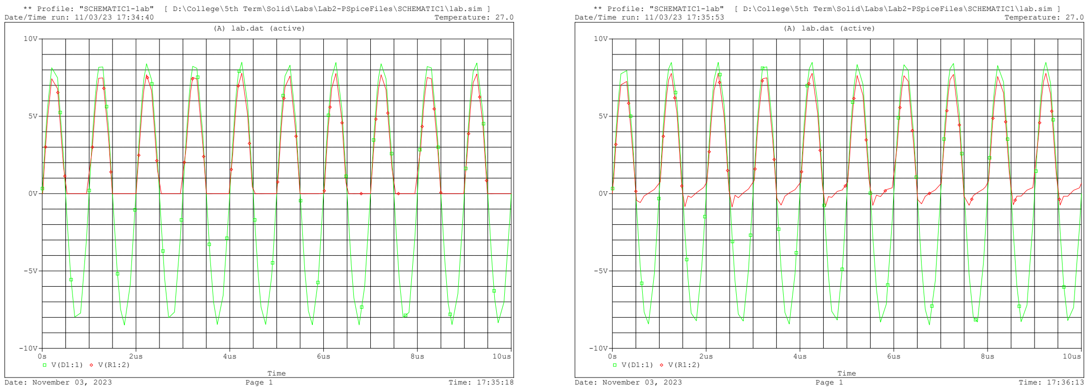


Figure 11: 3rd Circuit Simulation

3.1 Changing Parameters with Time



(a) Default

(b) $C_j = 20pF, M = 0.5, V_j = 0.75V$

Figure 12: Changing Parameters with Time

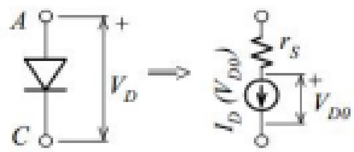
3.1.1 Discussion

The output in fig. a is have wave rectifier the output peak is less than input by 0.7V because of capacitance effect also we get here oscillations in the fig. b mode.

4 Appendix

STATIC PARAMETERS				
Symbol	**Usual SPICE Keyword**	**Parameter Name**	**Typical Value/ Range**	**Unit**
I_S	IS	Saturation current		A
n	N	Emission coefficient	$1-2$	
r_S	RS	Parasitic resistance		Ω
BV	BV	Breakdown voltage (positive number)		V
	IBV	Breakdown current (positive number)		A
		Note: $\mathtt{IBV} = \mathtt{IS}\ \frac{\mathtt{BV}}{V_t}$		

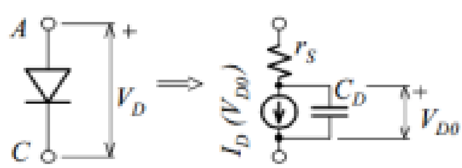
STATIC DIODE MODEL



$$I_D(V_{D0}) = \begin{cases} \mathtt{IS}\ (e^{V_{D0}/\ \mathtt{N}\ V_t} - 1) + V_{D0}G_{MIN} & \text{if } V_{D0} > \text{-}\mathtt{BV} \\ -\mathtt{IBV} & \text{if } V_{D0} = \text{-}\mathtt{BV} \\ -\mathtt{IS}\ [e^{-(\ \mathtt{BV}\ + V_{D0})/V_t} - 1 + \frac{\mathtt{BV}}{V_t}] & \text{if } V_{D0} < \text{-}\mathtt{BV} \end{cases}$$

DYNAMIC PARAMETERS				
Symbol	**Usual SPICE Keyword**	**Parameter Name**	**Typical Value/ Range**	**Unit**
$C_d(0)$	CJO	Zero-bias junction capacitance		F
V_{bi}	VJ	Built-in (junction) voltage	$0.65-1.25$	V
m	M	Grading coefficient	$\frac{1}{3}-\frac{1}{2}$	
τ_T	TT	Transit time		s

LARGE-SIGNAL DIODE MODEL



$I_D(V_{D0})$ is given in Table A.1

$C_D = C_d + C_s$

$C_d = \mathtt{CJO}\ (1 - \frac{V_{D0}}{\mathtt{VJ}})^{-\ \mathtt{M}}$ (for $V_{D0} < 0.5\mathtt{VJ}$)

$C_s = \mathtt{TT}\ \frac{dI_D}{dV_{D0}}$