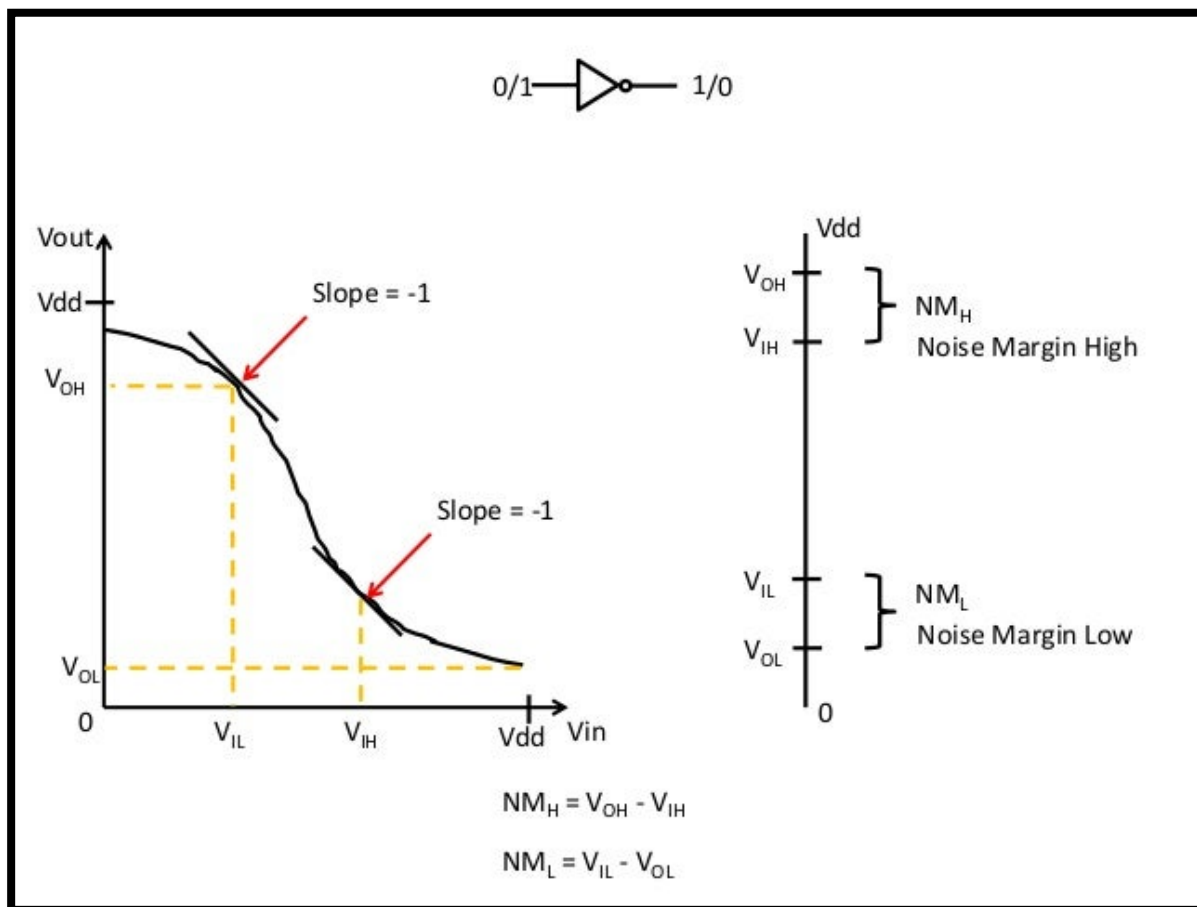Experiment 2

Aim: To perform the parametric sweep analysis on resistive load inverter to plot VTC Curve for different values of the load resistance and calculate the various critical parameter of VTC Curve for each case.

Tool Used: LTSPICE

Theory

VIL	Input Low Voltage
	Any voltage between 0 and VIL treated as Logic Zero
VOH	Output High Voltage
	Any output voltage level between VOH and VDD treated as Logic One
VIH	Input High Voltage
	Any Input voltage level between VIH and VDD will be treated as Logic One
VOL	Output Low Voltage
	Any output voltage level between Zero and VOL treated as Logic Zero

Switching Threshold: A point at which Vin = Vout at this point PMOS and NMOS both are in saturation state both transistors are on. High chances of leakage current flow.

Simulation

**Aim To perform the parametric sweep analysis on resistive load inverter
to plot the VTC Curve for different values of the load resistance and calculate
the various critical parameters of the VTC curve for each case.
DC SWeep Analysis to Plot VTC (Vout Vs Vin)**
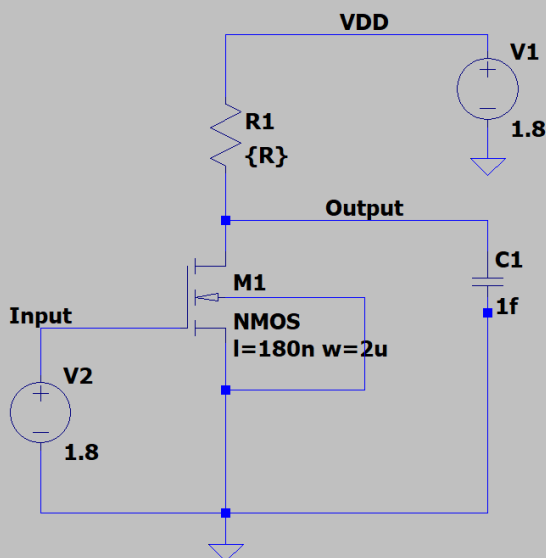
.dc V2 0 1.8 0.01

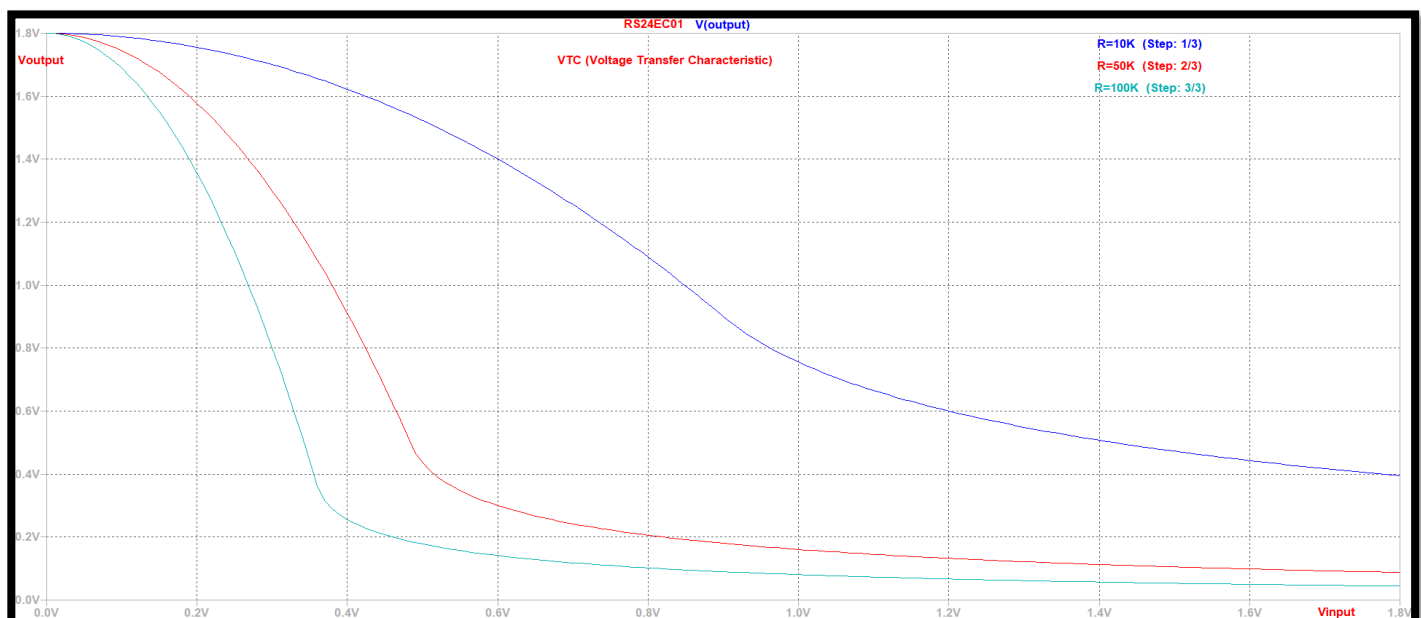**V2=Input, Start Value=0v,Stop Value=1.8v and Step Size =0.01v**

.step param R list 10k 50k 100k

.meas Vth WHEN V(Input)-V(Output)=0

Measurement: vth

step	R	v(input)-v(output)=0
1	10K	0.9
2	50K	0.486518
3	100K	0.36

Roll Number = RS24EC01

RS24EC01 V(output)

VTC (Voltage Transfer Characteristic)

R=10K (Step: 1/3)
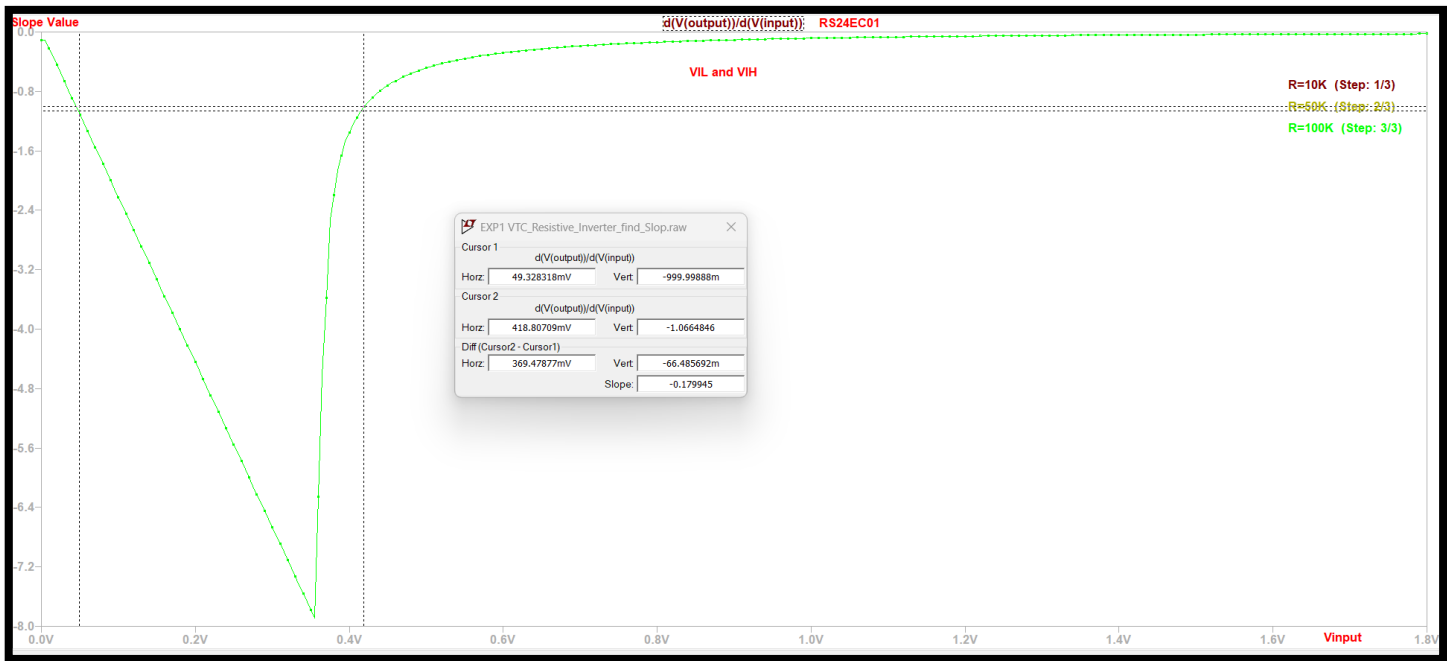R=50K (Step: 2/3)
R=100K (Step: 3/3)

Voutput

Vinput

Aim : To perform the parametric sweep analysis on resistive load inverter to plot
VTC Curve for different values of the load resistance and calculate the various critical parameter of VTC Curve for each case.
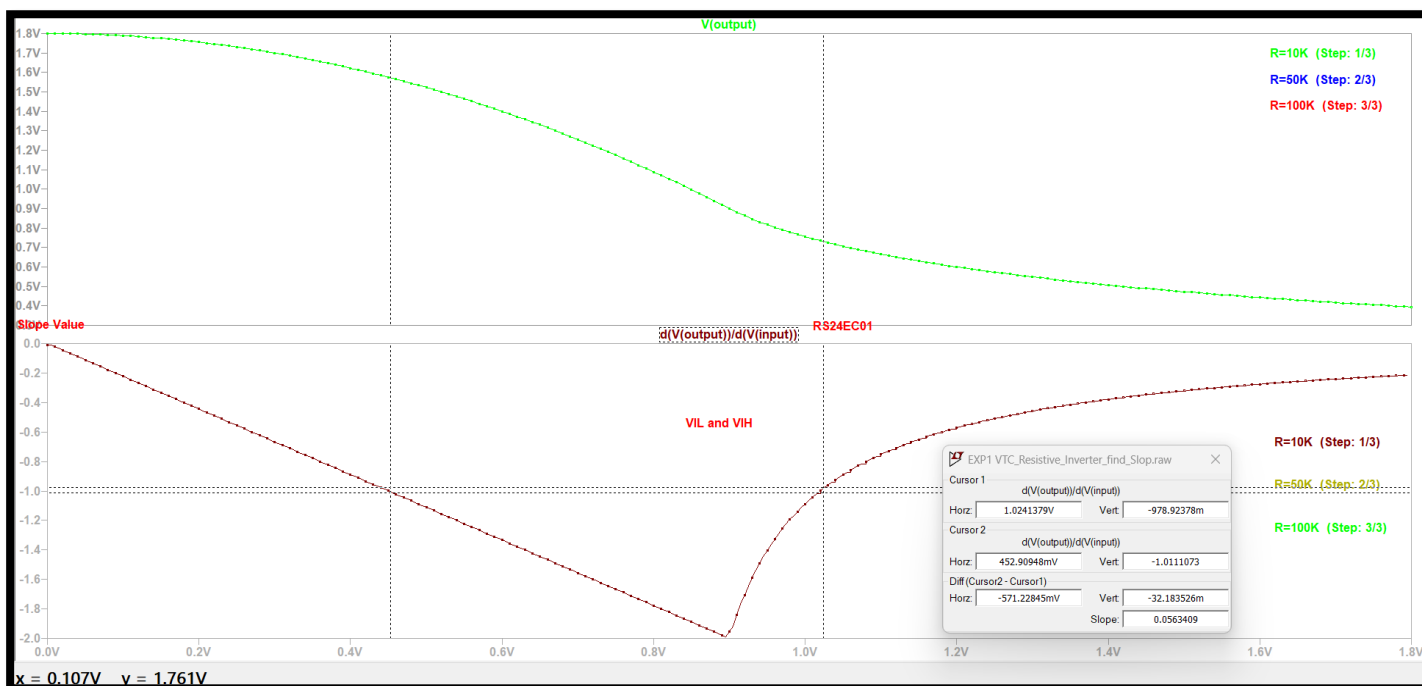**DC SWeep Analysis to Plot VTC (Vout Vs Vin)**


```
.dc V2 0 1.8 0.01

V2=Input, Start Value=0v,Stop Value=1.8v and Step Size =0.01v

.step param R list 10k 50k 100k
```

Roll Number = RS24EC01

Aim : To perform the parametric sweep analysis on resistive load inverter to plot VTC Curve for different values of the load resistance and calculate the various critical parameter of VTC Curve for each case.
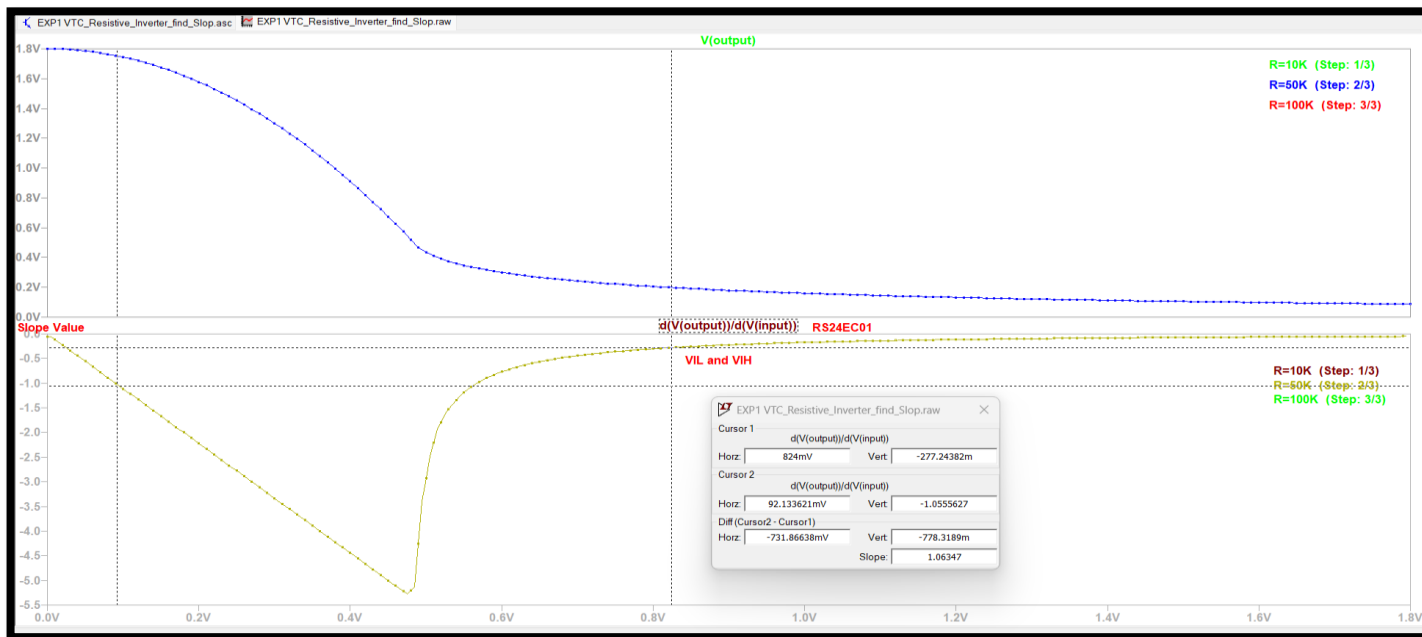**Transient Analysis**

Drain Current

VDD

V1

1.8

R1
{R}

Output

C1

1f

M1
NMOS
l=180n w=2u

Input

V2

PULSE(0 1.8 0 0.1n 0.1n 1n 2n)

.tran 0 5n 0.01n 0.01n

Stop time =5n , Time for Saving data =0.01n ,Step Size=0.01n

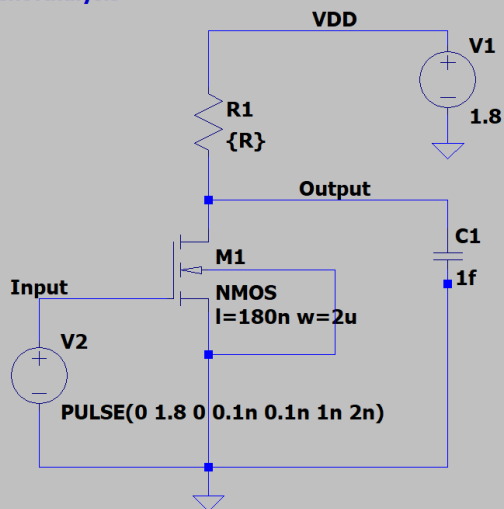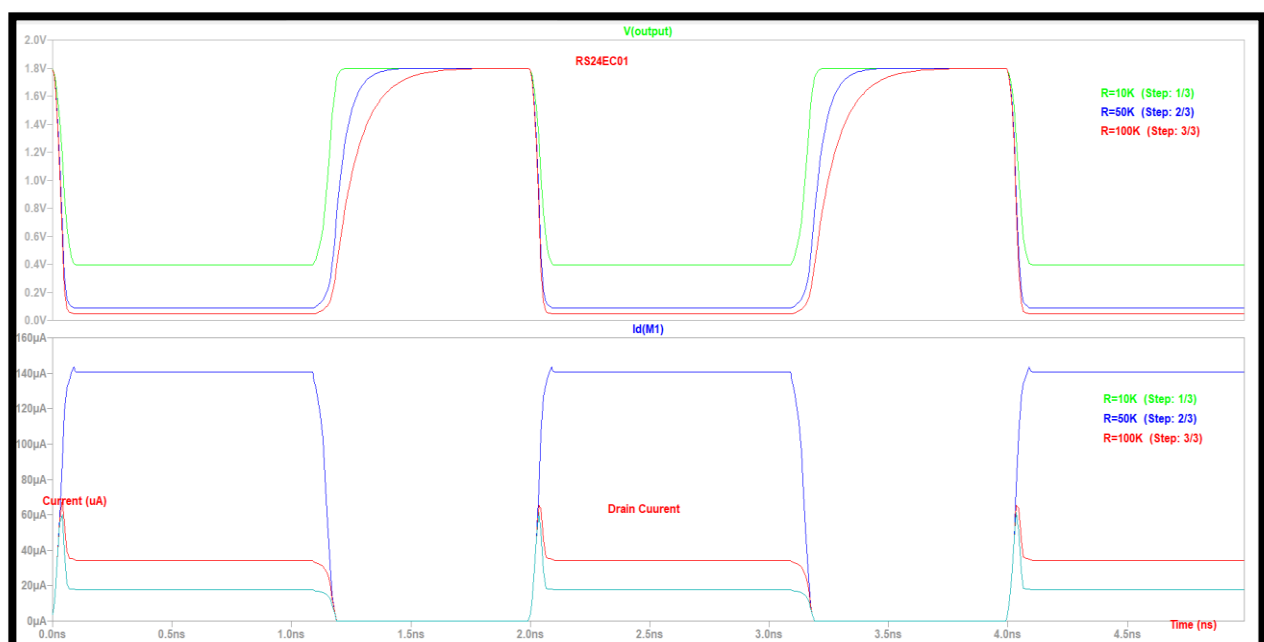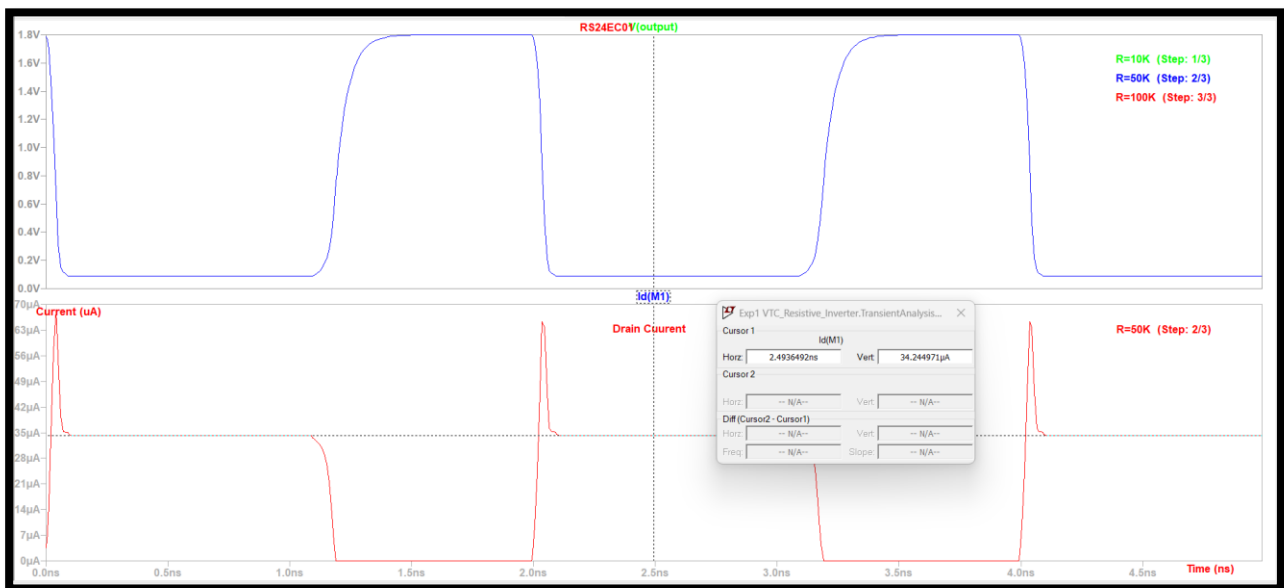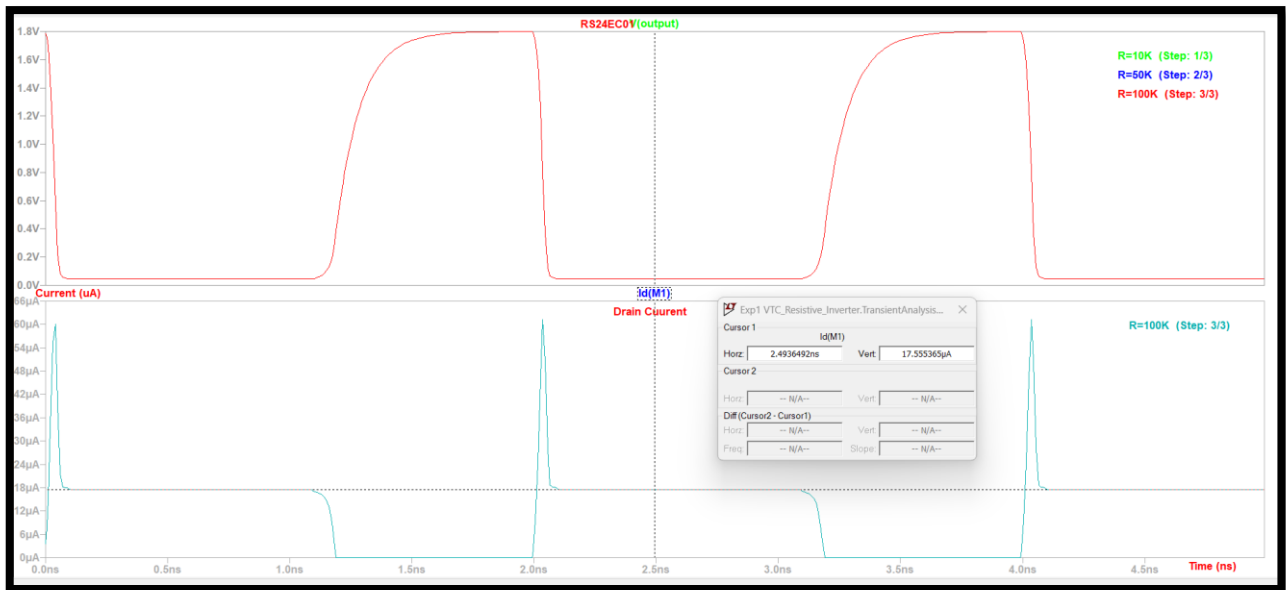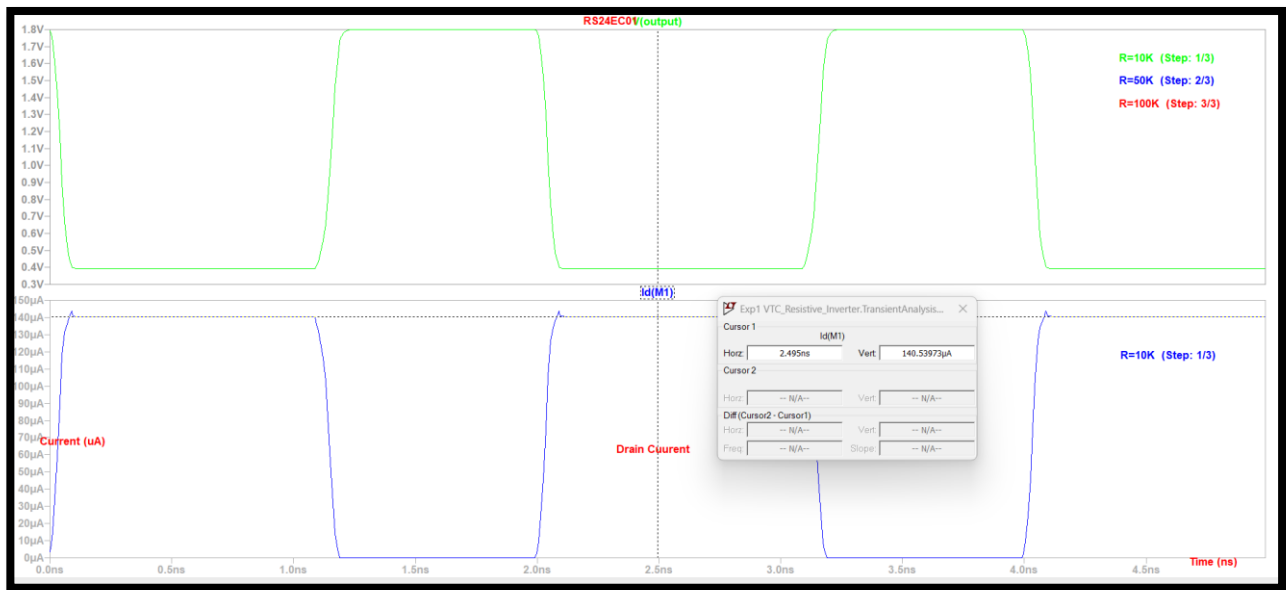.step param R list 10k 50k 100k

Roll Number = RS24EC01

Aim : To perform the parametric sweep analysis on resistive load inverter to plot VTC Curve for different values of the load resistance and calculate the various critical parameter of VTC Curve for each case.

Operating Points

VDD
V1
1.8

R1
100k

Output

M1
NMOS
l=180n w=2u

C1
1f

Input

V2
1.8

.op
;.step param R list 10k 50k 100k

--- Operating Point ---

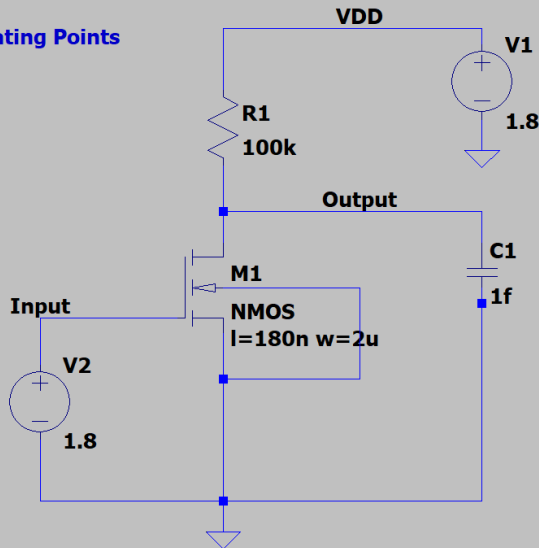|		
V(vdd):	1.8	voltage
V(output):	0.0444376	voltage
V(input):	1.8	voltage
Id(M1):	1.75556e-05	device_current
Ig(M1):	0	device_current
Ib(M1):	-5.26435e-14	device_current
Is(M1):	-1.75556e-05	device_current
I(C1):	4.44376e-29	device_current
I(R1):	1.75556e-05	device_current
I(V1):	-1.75556e-05	device_current
I(V2):	0	device_current

Roll Number = RS24EC01

Aim : To perform the parametric sweep analysis on resistive load inverter to plot VTC Curve for different values of the load resistance and calculate the various critical parameter of VTC Curve for each case.

Operating Points

VDD
V1
1.8

R1
50k

Output

M1
NMOS
l=180n w=2u

C1
1f

Input

V2
1.8

.op
;.step param R list 10k 50k 100k

--- Operating Point ---

V(vdd):	1.8	voltage
V(output):	0.0877514	voltage
V(input):	1.8	voltage
Id(M1):	3.4245e-05	device_current
Ig(M1):	0	device_current
Ib(M1):	-9.74152e-14	device_current
Is(M1):	-3.4245e-05	device_current
I(C1):	8.77514e-29	device_current
I(R1):	3.4245e-05	device_current
I(V1):	-3.4245e-05	device_current
I(V2):	0	device_current

Roll Number = RS24EC01

Circuit 1

Aim : To perform the parametric sweep analysis on resistive load inverter to plot VTC Curve for different values of the load resistance and calculate the various critical parameter of VTC Curve for each case.

Operating Points

VDD

V1
1.8

R1
100k

Output

C1
1f

M1
NMOS
l=180n w=2u

Input

V2
1.8

.op
;.step param R list 10k 50k 100k

--- Operating Point ---

V(vdd):	1.8	voltage
V(output):	0.0444376	voltage
V(input):	1.8	voltage
Id(M1):	1.75556e-05	device_current
Ig(M1):	0	device_current
Ib(M1):	-5.26435e-14	device_current
Is(M1):	-1.75556e-05	device_current
I(C1):	4.44376e-29	device_current
I(R1):	1.75556e-05	device_current
I(V1):	-1.75556e-05	device_current
I(V2):	0	device_current

Roll Number = RS24EC01

Circuit 2

Aim : To perform the parametric sweep analysis on resistive load inverter to plot VTC Curve for different values of the load resistance and calculate the various critical parameter of VTC Curve for each case.

Operating Points   **Power Calculations**
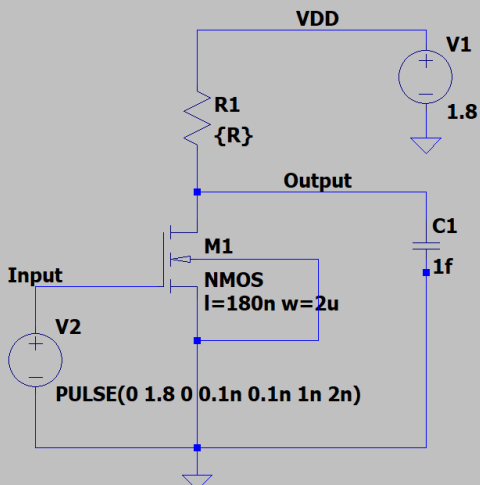
VDD

V1
1.8

R1
{R}

Output

C1
1f

M1
NMOS
l=180n w=2u

Input

V2

PULSE(0 1.8 0 0.1n 0.1n 1n 2n)

.tran 0 5n 0.01n 0.01n

Stop time =5n , Time for Saving data =0.01n ,Step Size=0.01n

.step param R list 10k 50k 100k

P=VI
AVG Power = Avg Current * VDD
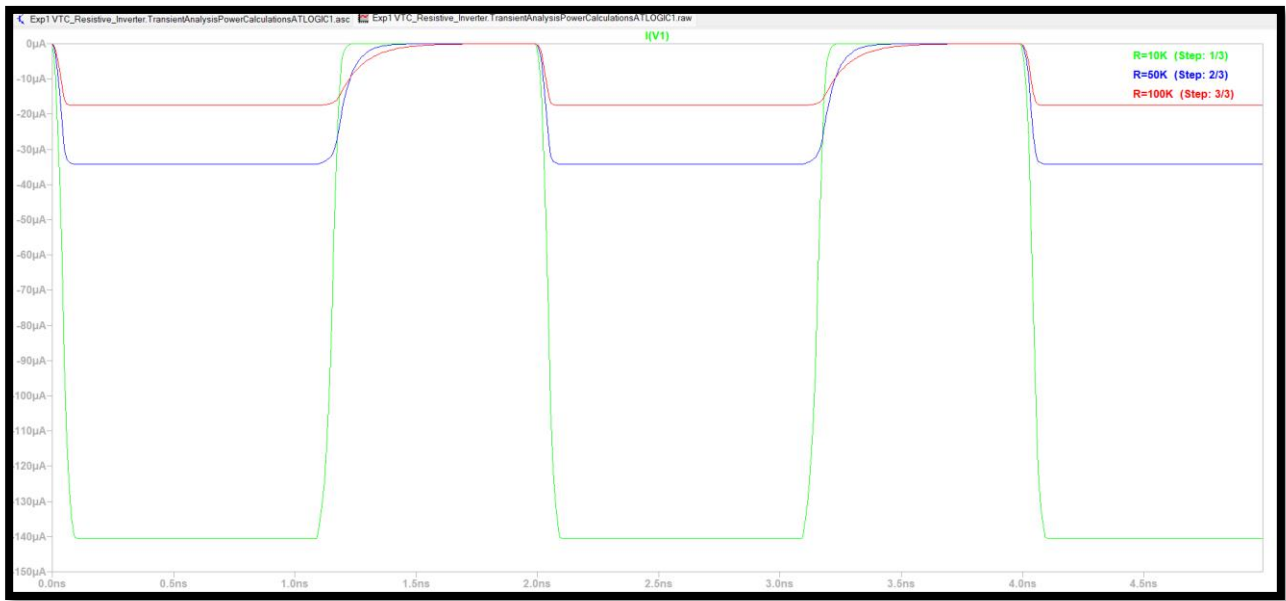$P=(12.052 \times 10^{-6}) \cdot 1.8$
$P=21.69 \mu W$

Roll Number = RS24EC01

Results

Parameters	Value in mv
R=100K	
VIL	49.328318mV
VIH	418.80709mV
VOL	44.485728mV
VOH	1.8v
Vm	0.36v
Transient Analysis	
Id	17.555365µA
Power Calculation	
Avg Current	12.052µA
Avg Power	12.052µA * 1.8V
R=50K	
VIL	92.133621mV
VIH	565.40948mV
VOL	87.846385mV

VOH	1.8V
Vm	0.486v
Transient Analysis	
Id	34.244971µA
Power Calculation	
Avg Current	22.727µA
Avg Power	22.727µA*1.8V
R=10K	
VIL	452.90948mV
VIH	1.0144397V
VOL	396.88669mV
VOH	1.8V
Vm	0.9v
Transient Analysis	
Id	140.53973µA
Power Calculation	
Avg Current	89.23µA
Avg Power	89.23µA*1.8V