Department of Electrical & Electronic Engineering
Brac University
Semester: Spring 25

EEE101L

ELECTRICAL CIRCUITS I LABORATORY

Section: 05

Project

Prepared by: Every member of Group 05 contributed to each segment by working together collaboratively.
Group Number: 05
Group members:

SL	Student ID	Name
01.	24104215	Shreya Das
02.	24121205	Souvik Barman Ratul
03.	24121280	Tanisha Hannan
04.	24121308	Alif Tamjid

Objective: Design a circuit which will give a fluctuating DC Output voltage for an Input Square Wave.

Design & Calculation:- The input square wave is used to calculate the driving voltage across the capacitor using Thevenin's theorem. The circuit reduces to a Thevenin resistance and capacitance when the capacitor serves as a load. With a smaller peak amplitude of 10 V, the driving voltage transforms into a square wave. The oscillating DC output is caused by the charging and discharging behavior of the capacitor.

Given that,

V1= (19+G) =(19+5)=24 V [G=5]

V2=0V

TD=0

TR=0.0001u

TF=0.0001u

f=(20xG)=(20x5)=100Hz [G=5]

PER=1/f=1/100=0.01s

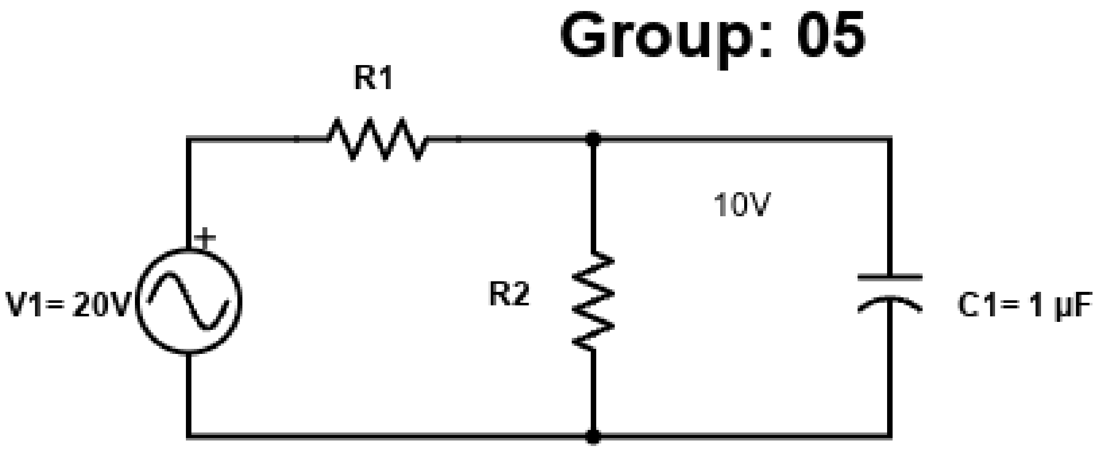
PW=PER/2=0.01/2=0.005s

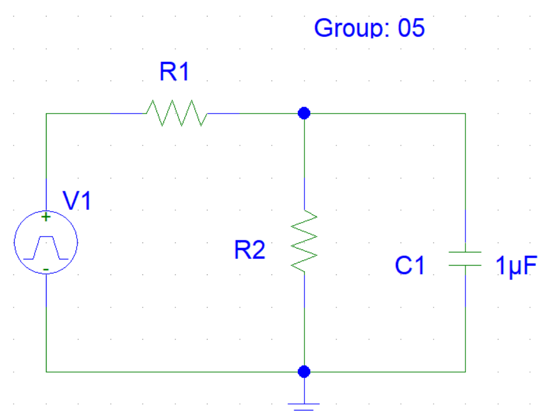
□(Time Constant)= 1ms = 1 × 10^(-3) s

V_{th}=10V

Time period for one cycle= 0.01s

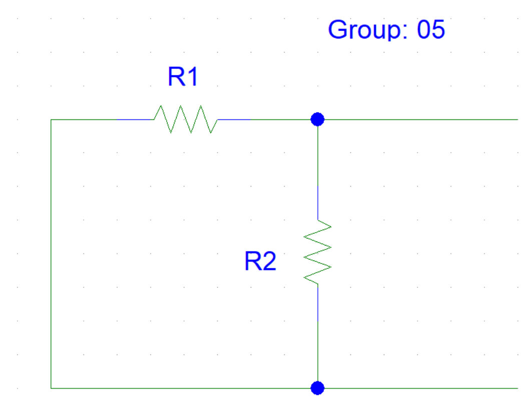
Time period for ten cycle=(0.01*10)= 0.1s=100ms



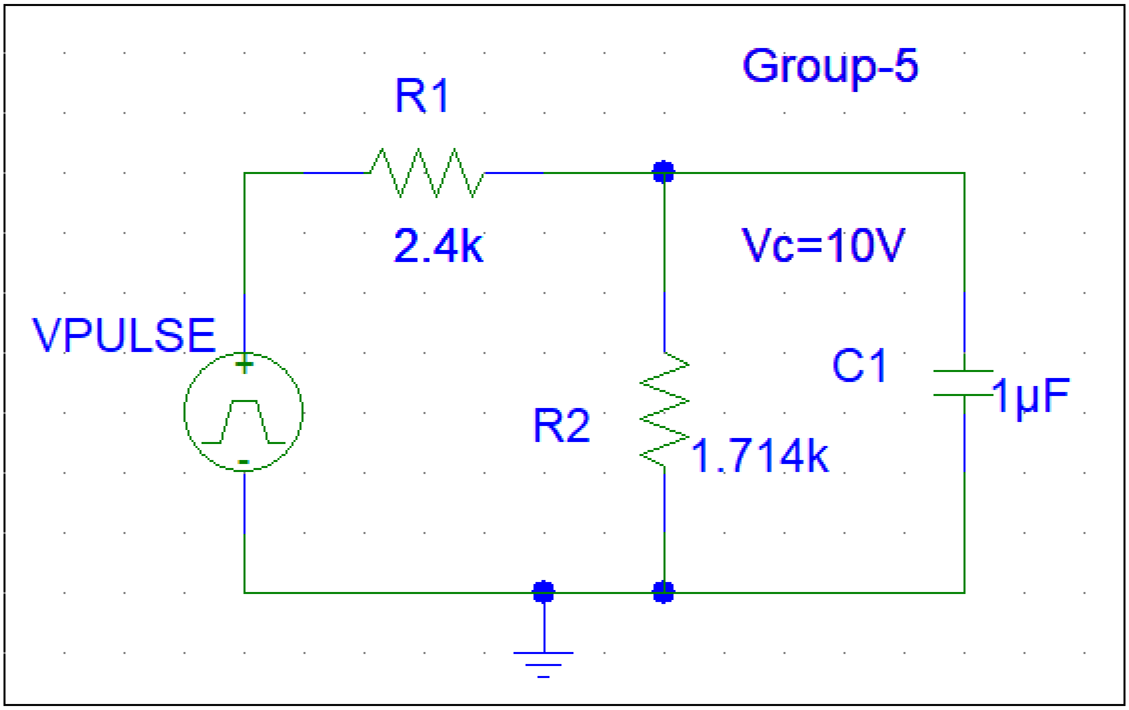


According to Voltage divider Rule,

Vth=R2/(R1+R2) x VPULSE
Or, 10=R2/(R1+R2) x 24
Or, 10R1+10R2=24R2
Or, 10R1=14R2
Or, R1= 1.4R2….. (1)



Let assume,
C=1uF
Now,
□=R_{th} x C
or,1ms=R_{th} x 1uF
R_{th}=1000Ω ….. (2)



Rth= R1 || R2

Or, Rth = (R1 × R2) / (R1 + R2)

Or, 1000 = (1.4R2 × R2) / (1.4R2 + R2)

Or, 1000 = 1.4 (R2)^(2) / 2.4 R2

Or, 1000 = 1.4 R2 / 2.4

Or, R2= (1000 × 2.4) / 1.4

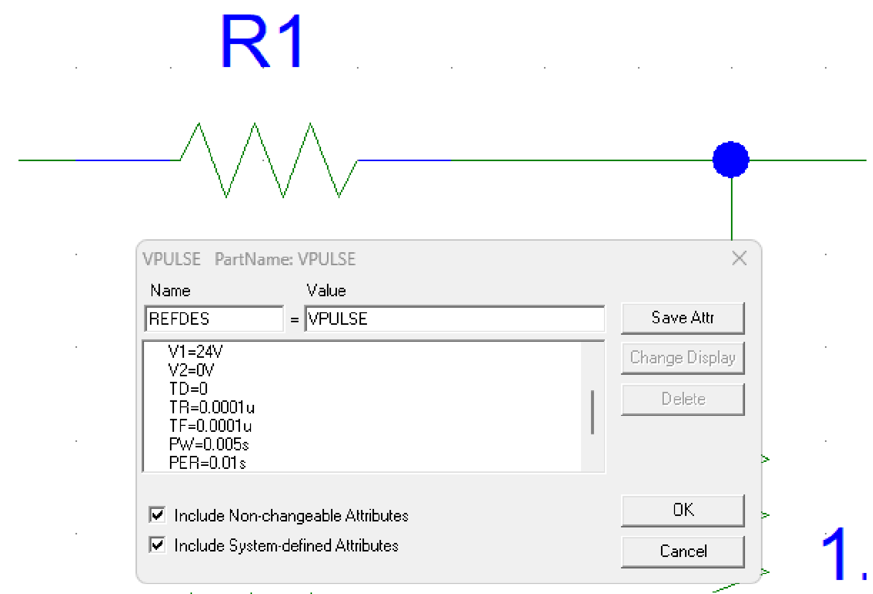
Or, R2 = 1714.29 Ω

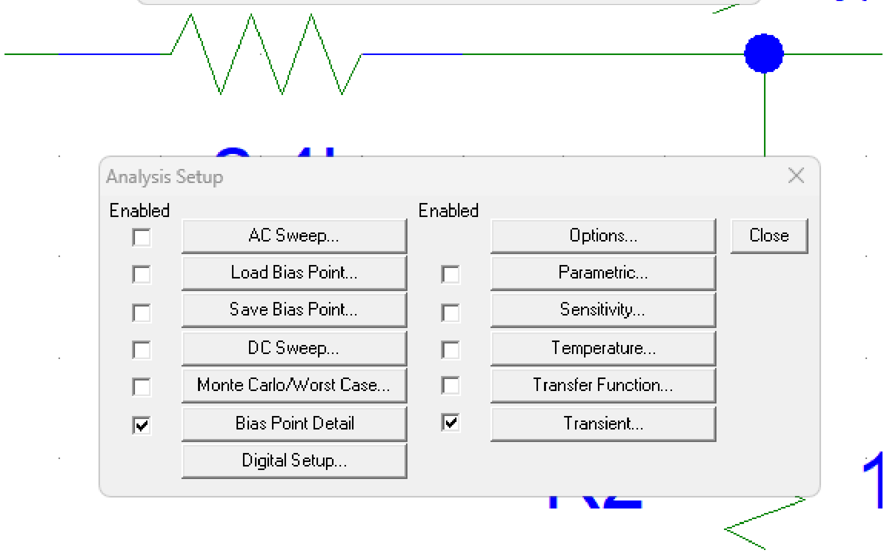
Or, R2 = 1.714 kΩ

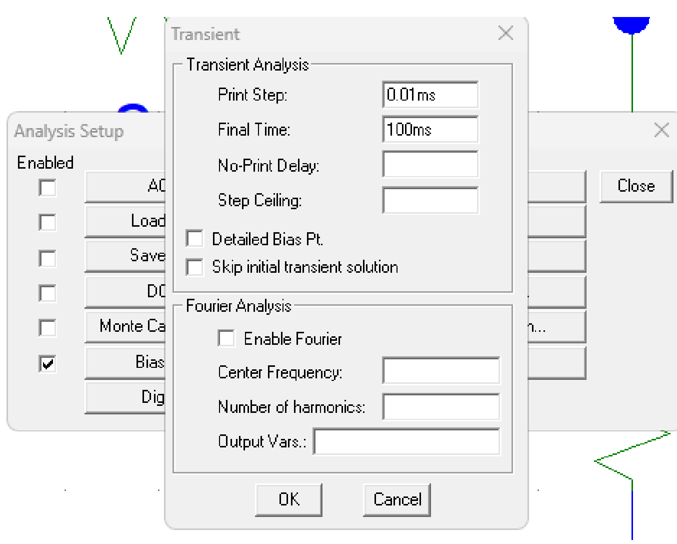
From 1 no. equation,

R1 = 1.4 × 1.714 kΩ

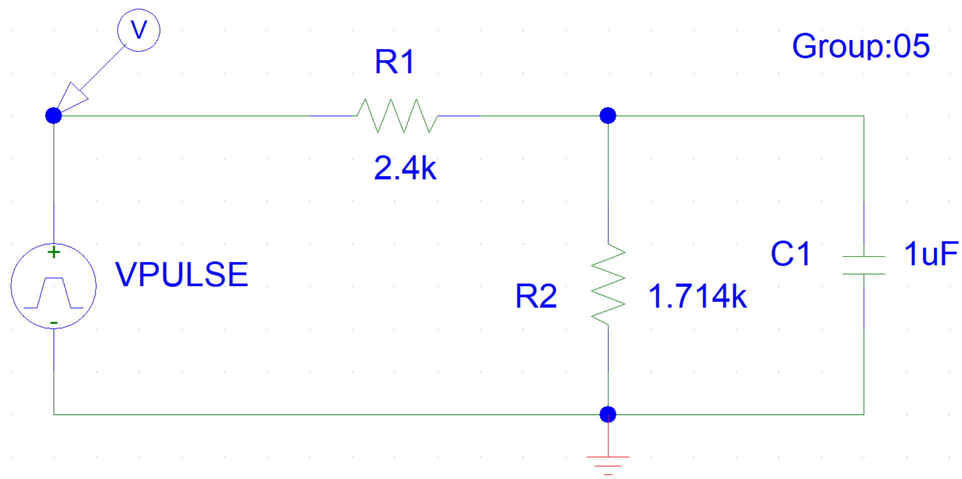
Or, R1 = 2.4 kΩ

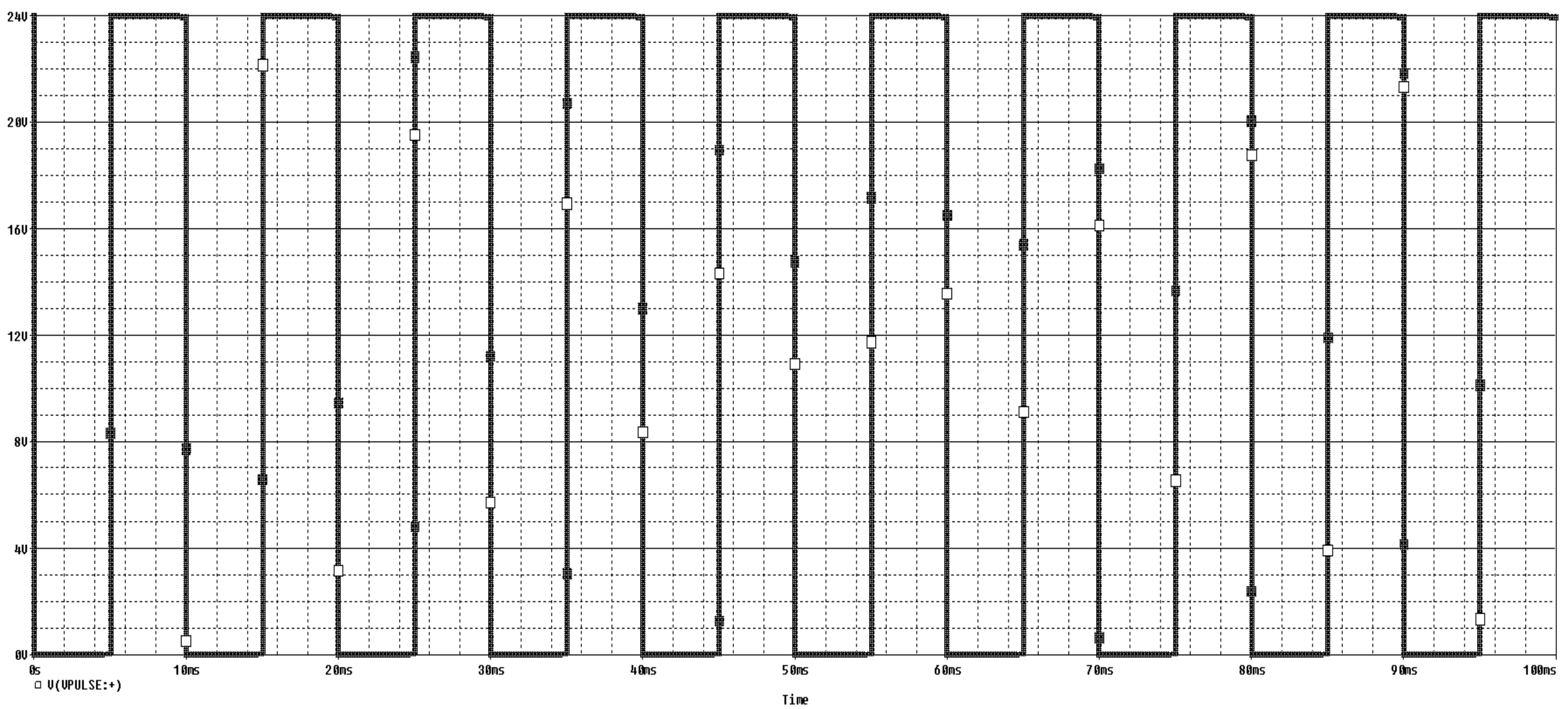

R1
VPULSE PartName: VPULSE
Name
Value
REFDES
=
VPULSE
Save Attr
Change Display
Delete
V1=24V
V2=0V
TD=0
TR=0.0001u
TF=0.0001u
PW=0.005s
PER=0.01s
Include Non-changeable Attributes
Include System-defined Attributes
OK
Cancel
1.


Analysis Setup
Enabled
AC Sweep...
Load Bias Point...
Save Bias Point...
DC Sweep...
Monte Carlo/Worst Case...
Bias Point Detail
Digital Setup...
Enabled
Options...
Parametric...
Sensitivity...
Temperature...
Transfer Function...
Transient...
Close
1

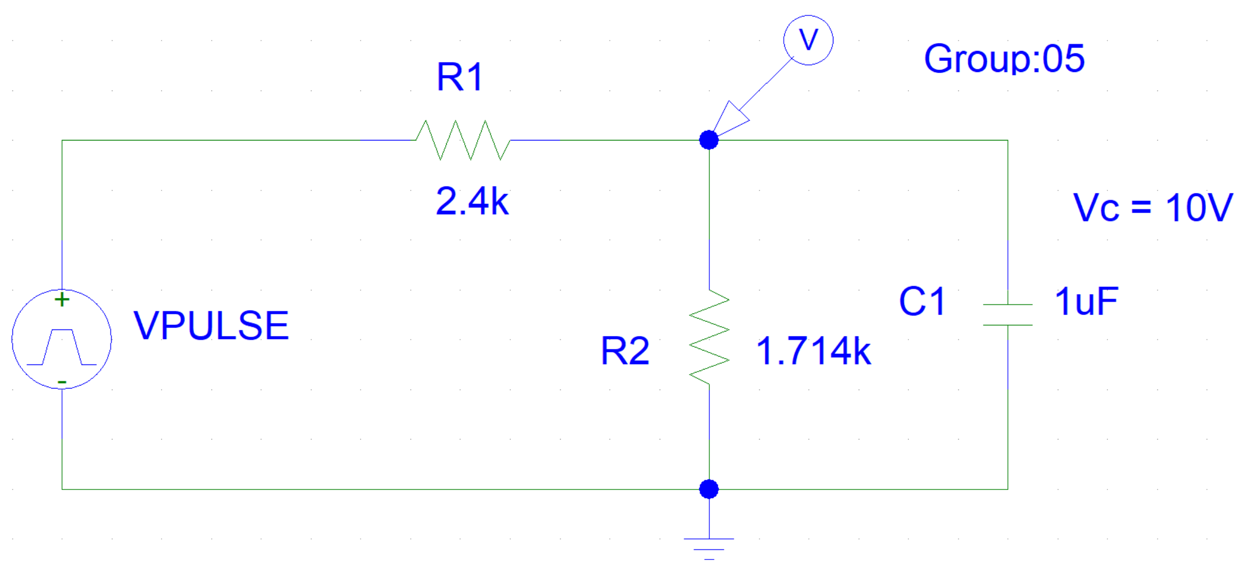

Transient
Transient Analysis
Print Step:
0.01ms
Final Time:
100ms
No-Print Delay:
Step Ceiling:
Detailed Bias Pt.
Skip initial transient solution
Fourier Analysis
Enable Fourier
Center Frequency:
Number of harmonics:
Output Vars.:
OK
Cancel
Analysis Setup
Enabled
Close

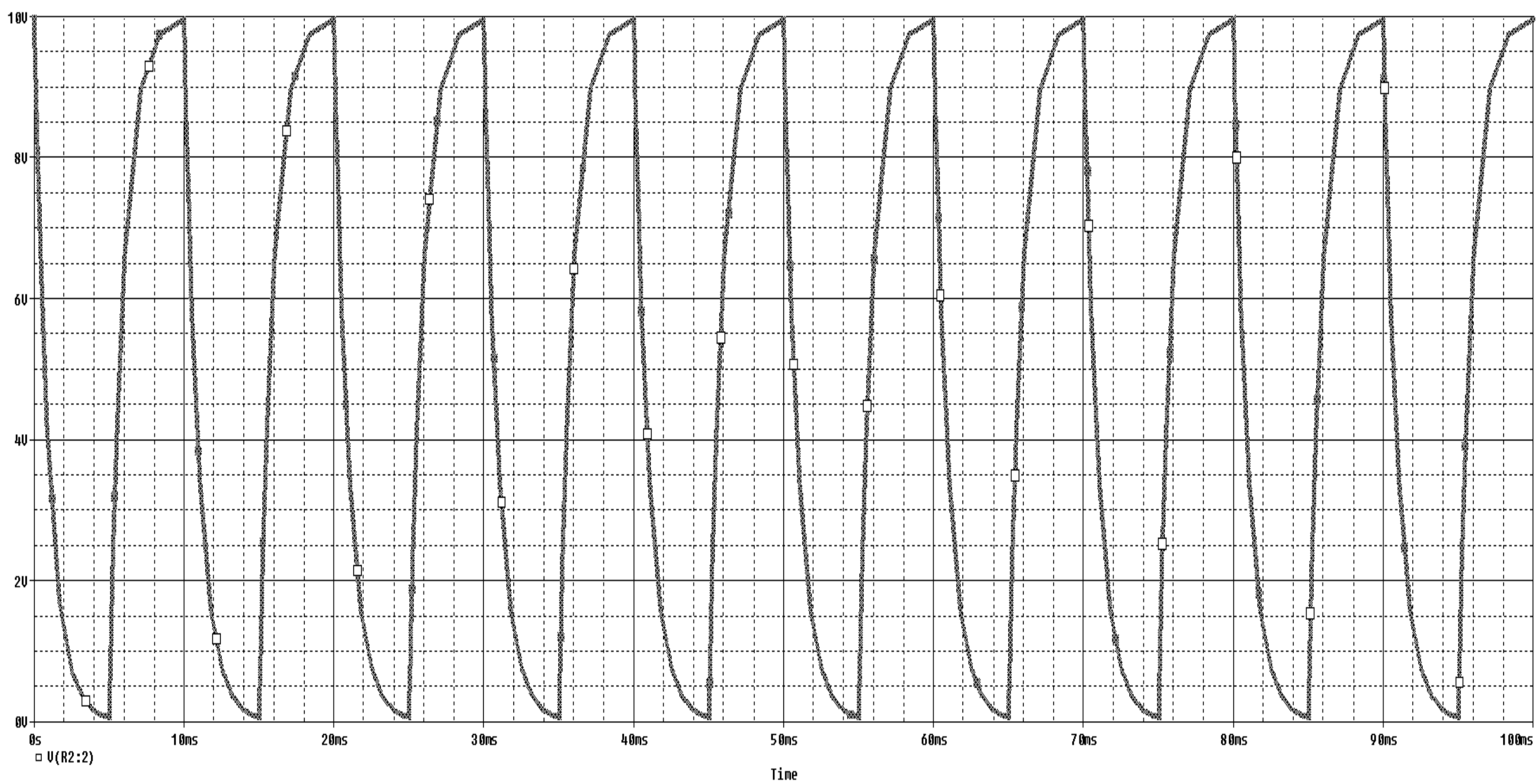
Simulation of Vs:



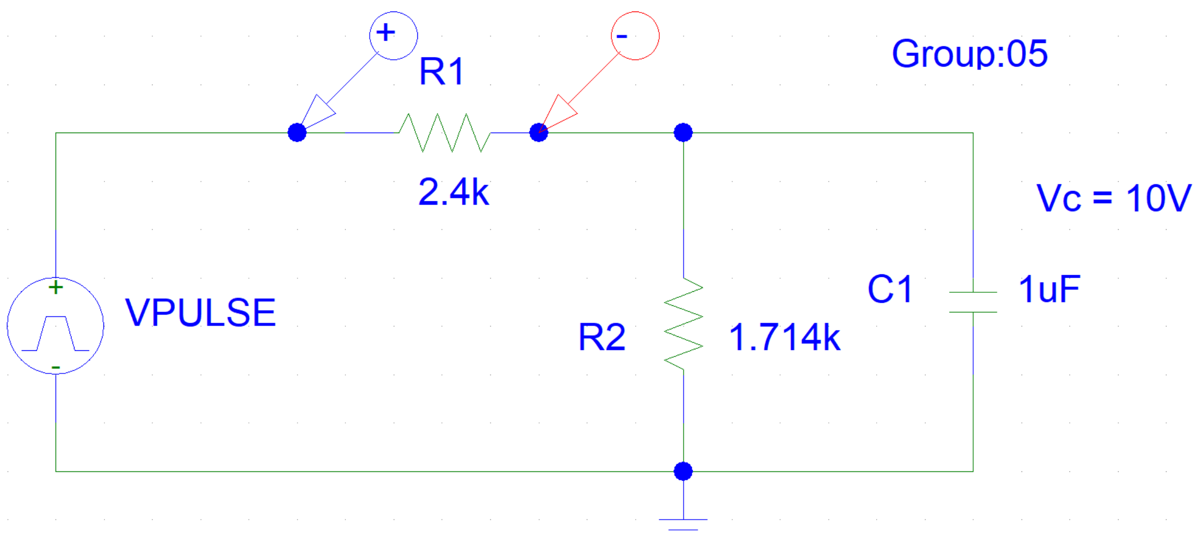


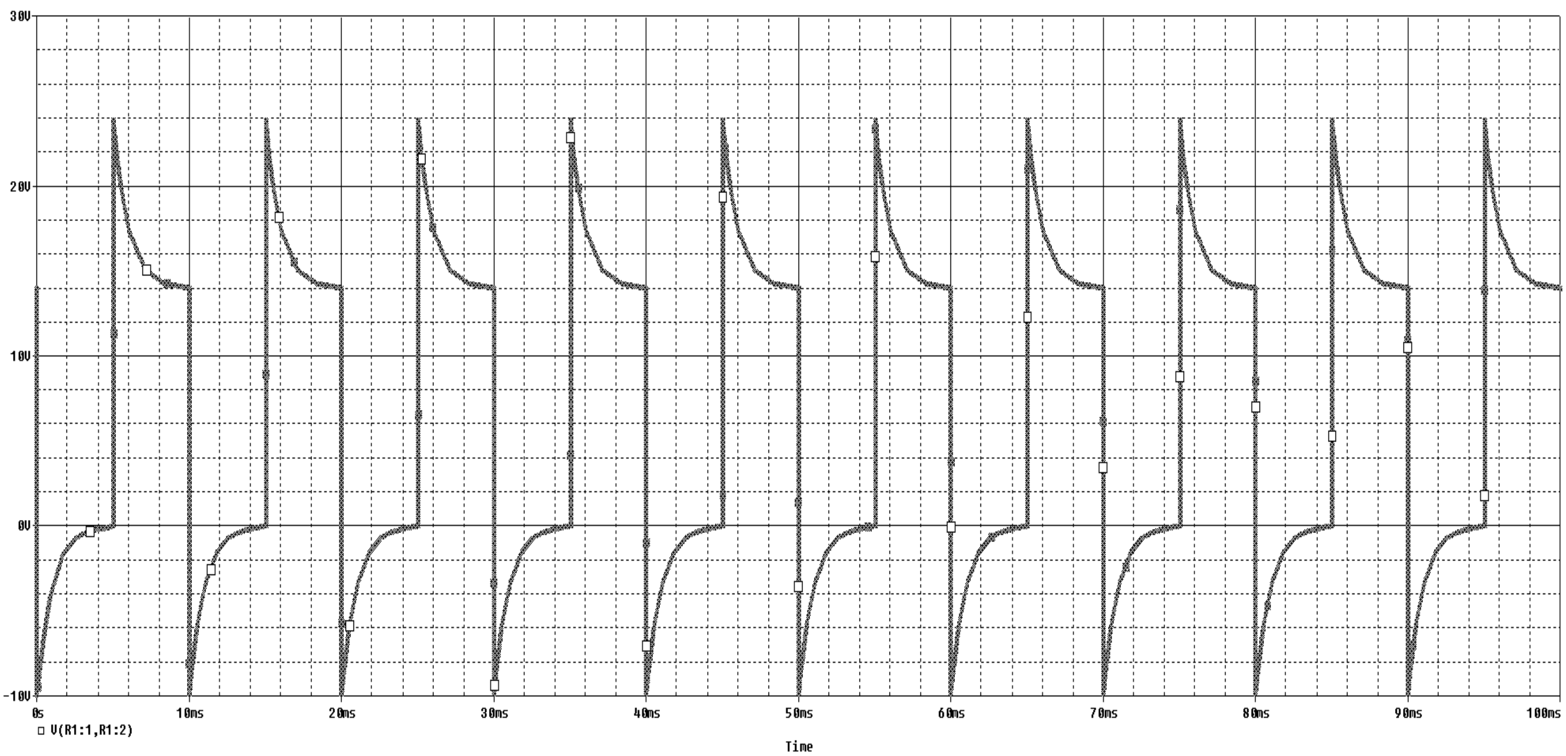
Simulation of Vc:



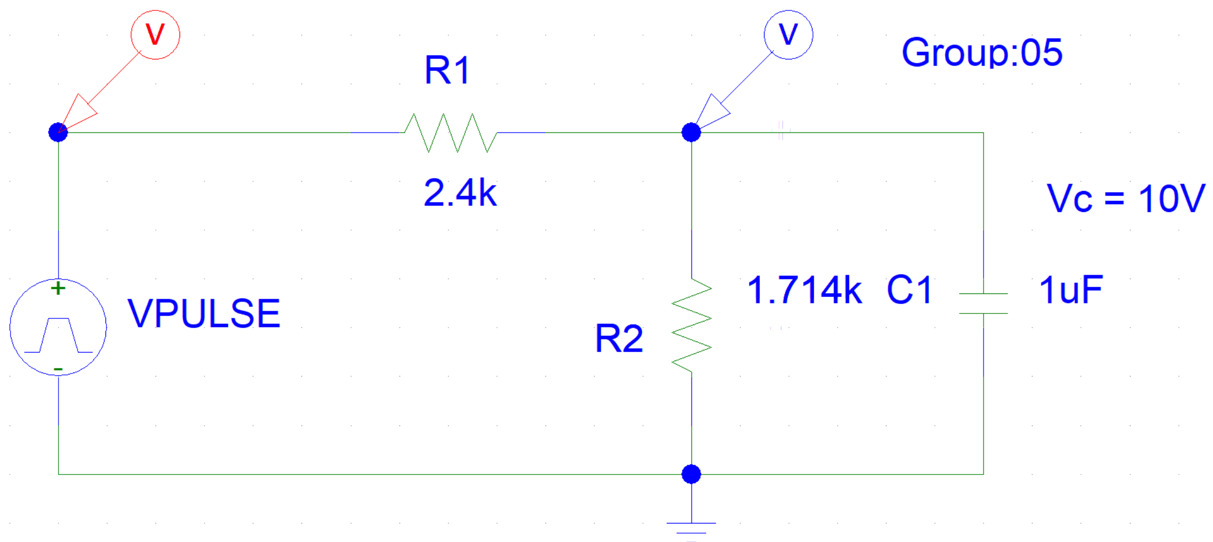


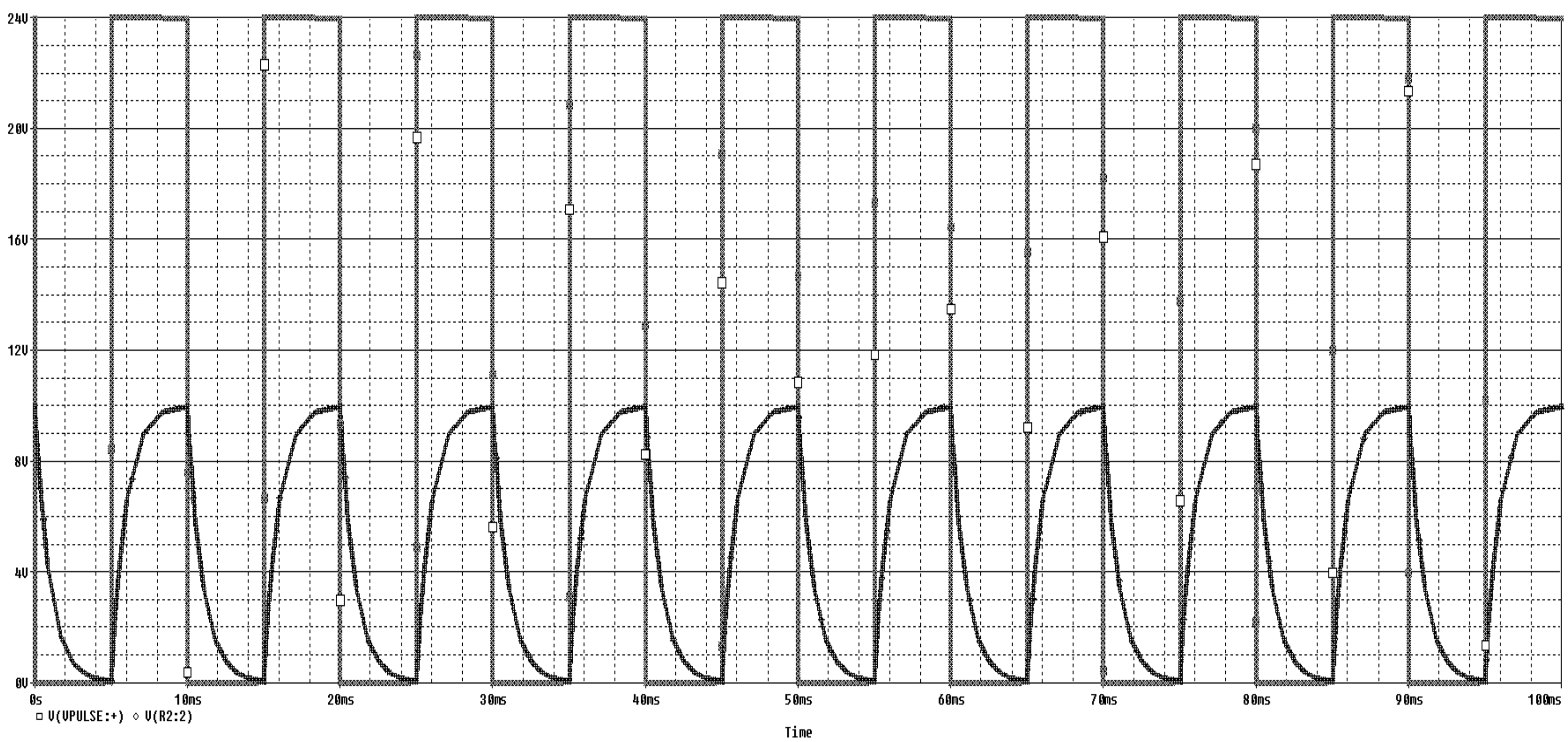
Simulation of Vr:



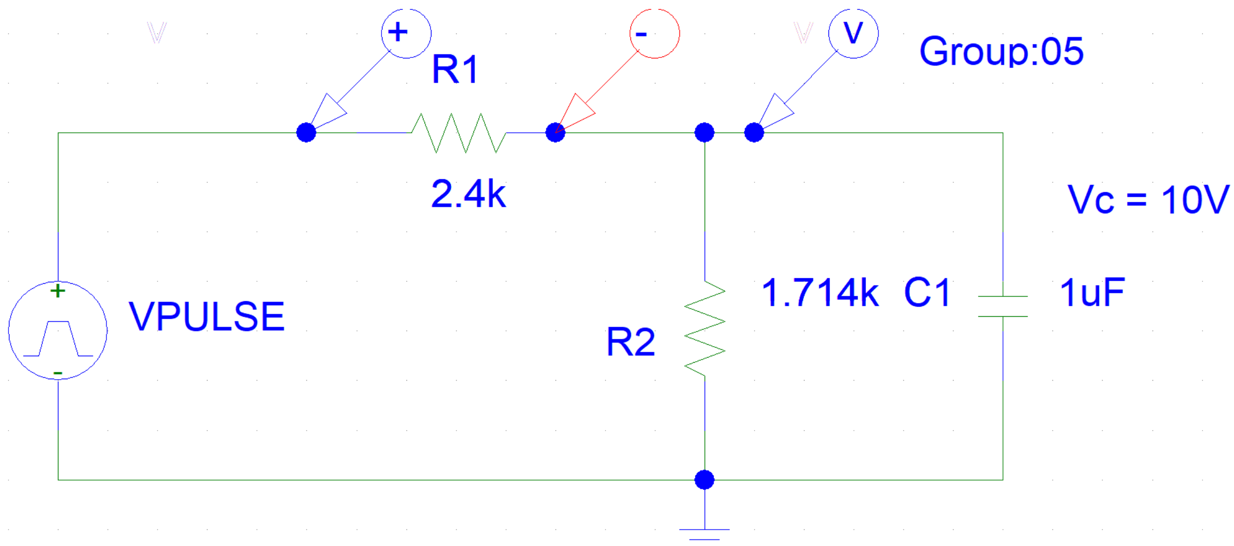


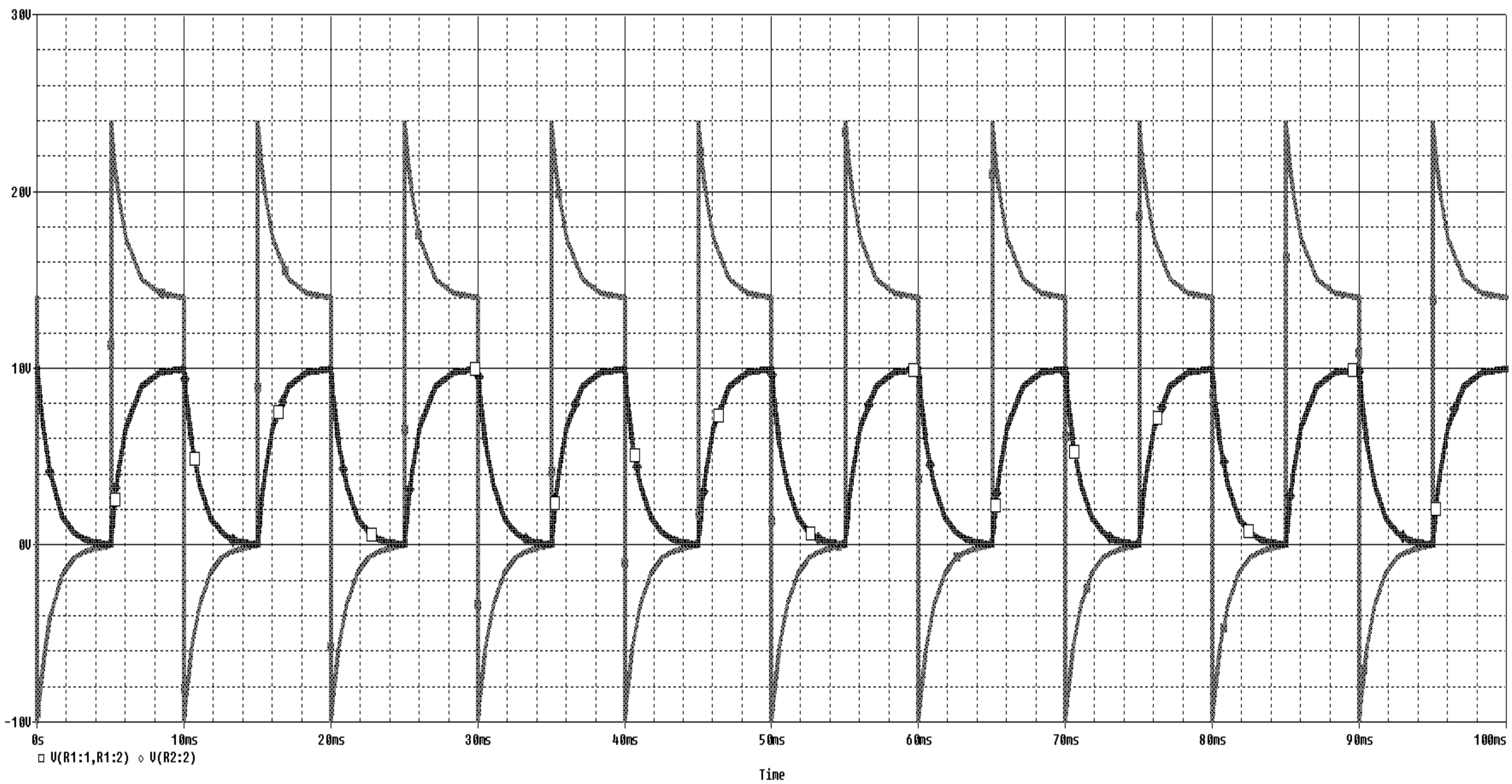
Simulation of (Vs-Vc):



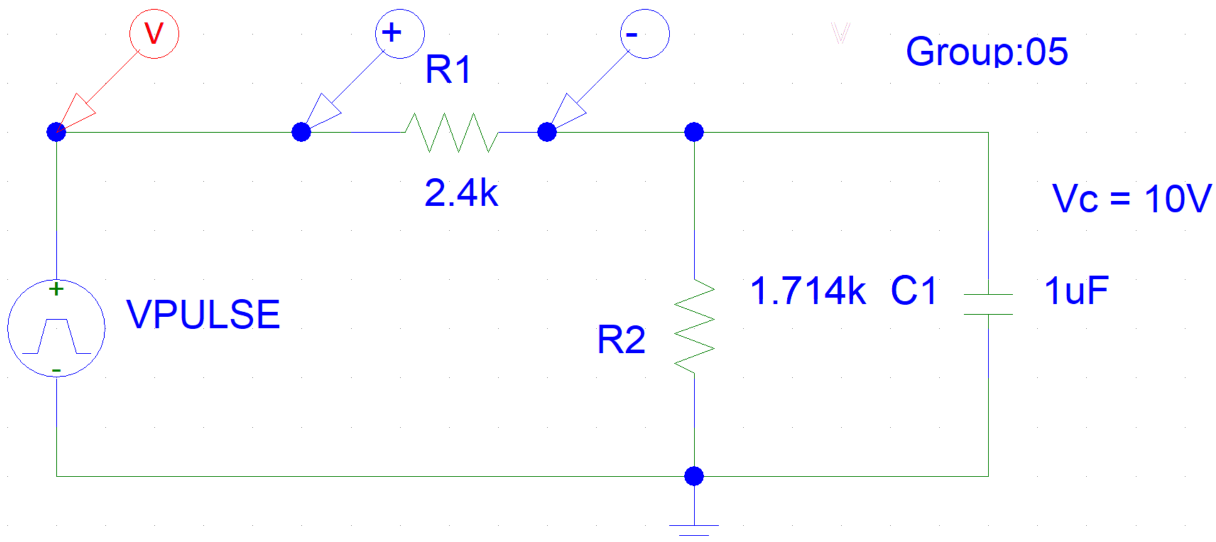


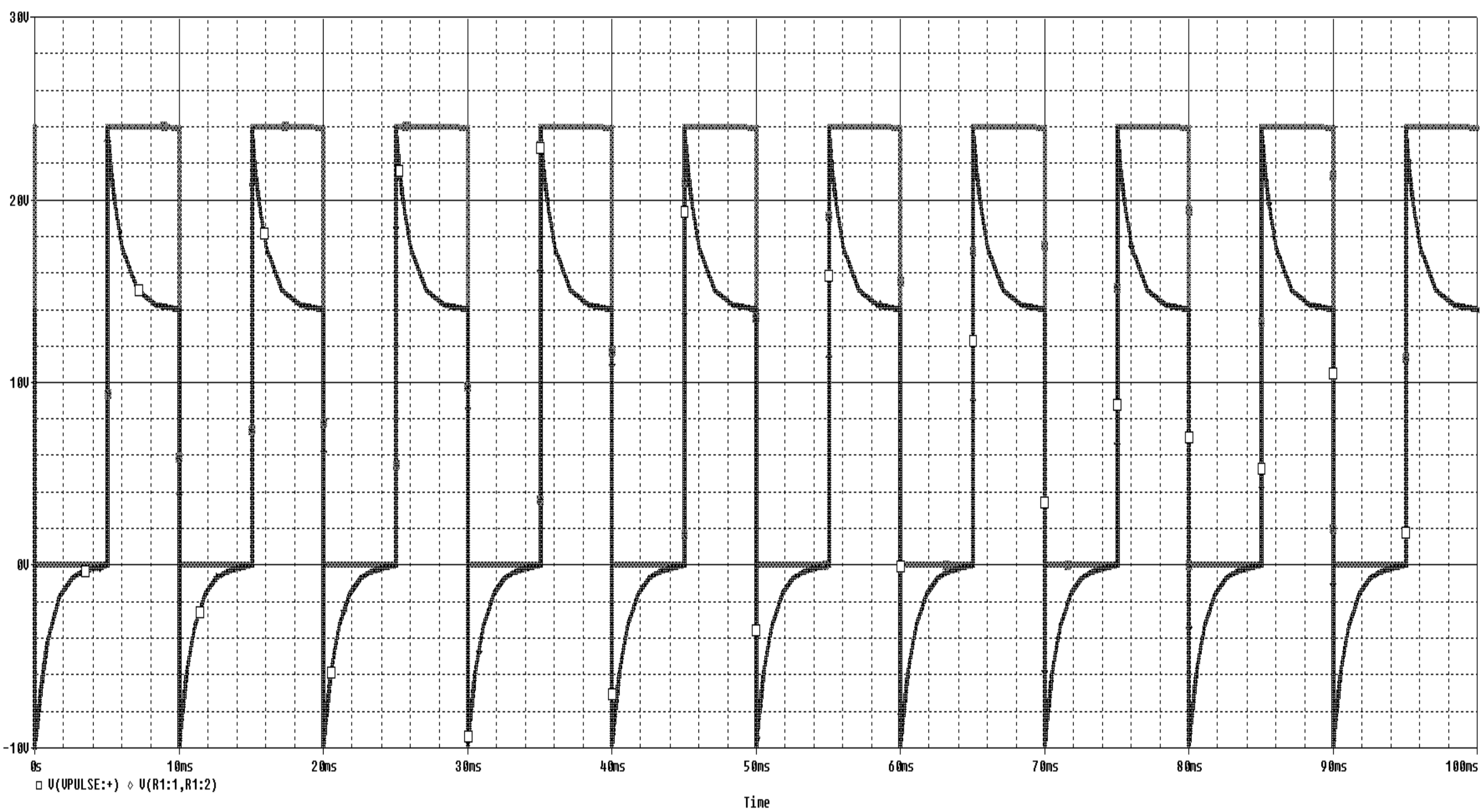
Simulation of (Vc-Vr):



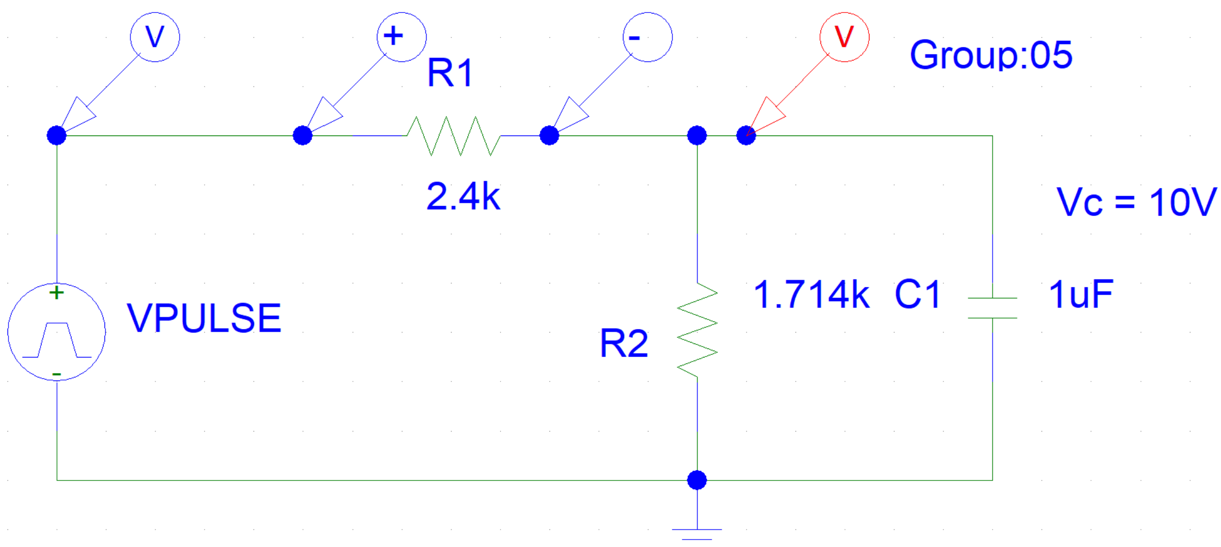


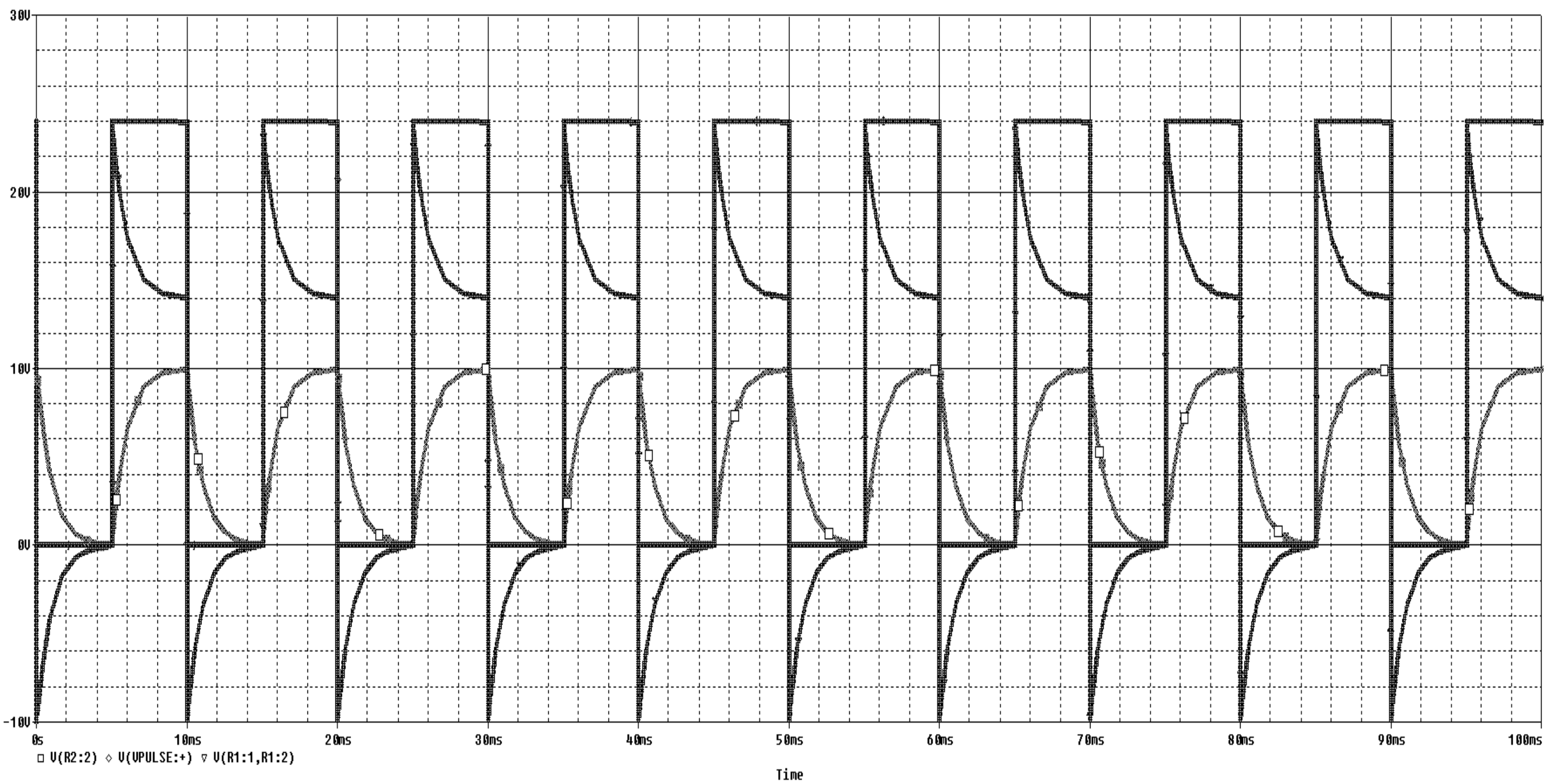
Simulation of (Vs-Vr):





Simulation of (Vs-Vc-Vr):





Verification:

To verify the accuracy of our theoretical calculations, we analyzed the circuit's behavior using simulations. The simulations of different node voltages (Vs, Vc, Vr) and their combinations (Vs - Vc, Vc - Vr, Vs - Vr, Vs - Vc - Vr) confirmed the expected behavior of the circuit. The input square wave (Vs) alternated between 24 V and 0 V as defined. The capacitor voltage (Vc) displayed a charging and discharging curve consistent with the RC time constant of 1 ms, validating the exponential nature of capacitor behavior in response to a square wave input. The voltage across the resistor (Vr) and the combination waveforms matched theoretical predictions, confirming the values of R1 = 2.4 kΩ and R2 = 1.714 kΩ derived from Thevenin's theorem and voltage divider principles. The simulation results over multiple cycles further validated that the circuit achieved a fluctuating DC output, meeting the objective of the project. This consistent match between theoretical expectations and simulation results verifies the correctness of our calculations and circuit design.

Conclusion:

In this project, we successfully designed and analyzed an RC circuit to generate a fluctuating DC voltage from a square wave input. By applying Thevenin's theorem and the voltage divider rule, we derived appropriate resistor values and selected a capacitor value to achieve a time constant of 1 ms. Our theoretical analysis was validated through simulation, which demonstrated accurate charging and discharging behavior of the capacitor. The project illustrates fundamental principles of transient response in RC circuits and confirms the effectiveness of simulation as a verification tool in circuit analysis.