

| Lab 1 – RC Transient Response |

Name: Tejas kaushik GUID: 3049840k

Objective

To measure and analyse the transient response of an RC circuit, determine its time constant from oscilloscope readings, deduce R and C values, and verify results by simulation.

1. Equipment used

Item	Model / Details
Oscilloscope	Keysight DSOX1202G
Function Generator	Built-in WaveGen
Digital Multimeter	Keysight 34461A
RC Box Number	7
Software	OrCAD / PSpice (Time-Domain Transient)

2. Theoretical Background

Milestone 1

$$v(t) = v_f + (v_i - v_f) e^{-\frac{t}{\tau}}$$

$\tau = RC$ At $t = \tau$:

$$v(\tau) = v_f + (v_i - v_f) e^{(-1)}$$

3. Experimental setup

Connections: Signal generator → RC input + Scope CH1; RC output → Scope CH2

Signal Settings: Frequency 500 Hz, Amplitude 3.0 Vpp, Offset 0 V, Square Wave, Trigger CH1 Rising Edge, DC Coupling

4. Measurements

Milestone 2

Input Voltage Levels and Target $v(\tau)$:

Parameter		Symbol	Value	Units
Initial Voltage		V_i	-1.5	V
Final Voltage		V_f	+1.5	V
Calculated $v(\tau)$		$v(\tau) = V_f + (V_i - V_f)e^{-\frac{t}{\tau}}$	+0.347	V

Milestone 3

Measured Time Constants:

Condition	X1 (μs)	X2 (μs)	ΔX (μs)
Button Up ($R = 3.3k\Omega$)	-4	152	156
Button Held ($R = 0$ only)	0	94	94

- Oscilloscope readings



↑ BUTTON UP ($R+3.3K\Omega$) ↑



↑ BUTTON HELD (R ONLY) ↑

5. Calculation

Milestone 4

Quantity	Formula	Result	Units
Capacitance	$C = (\tau_1 - \tau_2) / 3.3k\Omega$	18.8	nF
Resistance	$R = \tau_2 / C$	5.0	K ω

6. Verification

Milestone 5

Measurement	Instrument / Method	Value	Units
R_measured	Multimeter	5004	Ω
R_calculated	From τ	5000	Ω

7. Simulation

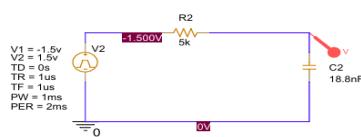
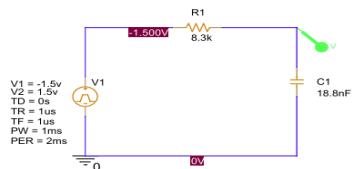
Milestone 6

Circuit: RC network driven by VPULSE.

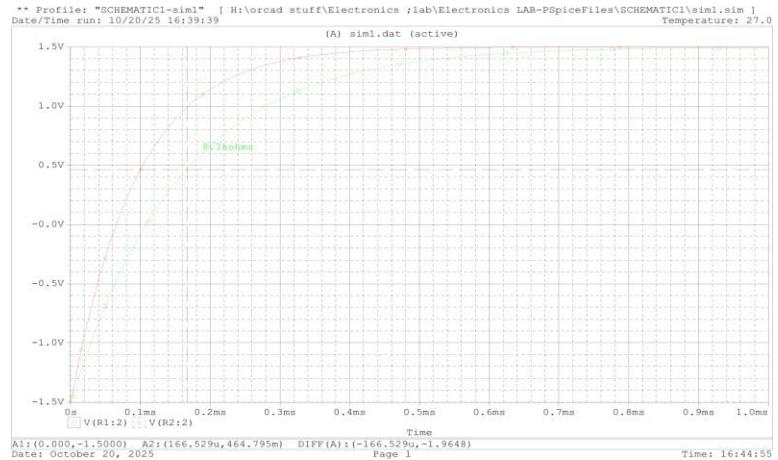
Parameters: $R_1=8.3k\Omega$, $R_2=5k\Omega$, $C=18.8nF$, Source=VPULSE(-1.5V to +1.5V, 500Hz, TR=1μs).

Simulation setup: Transient 6ms, max step 1μs.

- Results and schematic



SCHEMATIC



↑ SIMULATION PSPICE ↑

Case	R (kΩ)	Simulated τ (μs)	Experimental τ (μs)
Button Held	5.0	94	94
Button Up	8.3	156	156

8. Conclusion

The transient response of the RC circuit was analysed successfully. Measured $\tau_1=156\mu\text{s}$ and $\tau_2=94\mu\text{s}$ gave $C=18.8\text{nF}$ and $R=5.0\text{k}\Omega$. Simulation results matched experimental data, confirming validity of the analysis.