

| Lab 1 – RC Transient Response |

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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 $v(\tau)$		$v(\tau)=V_f+(V_i-V_f)e^{-1}$	+0.347	V

Milestone 3

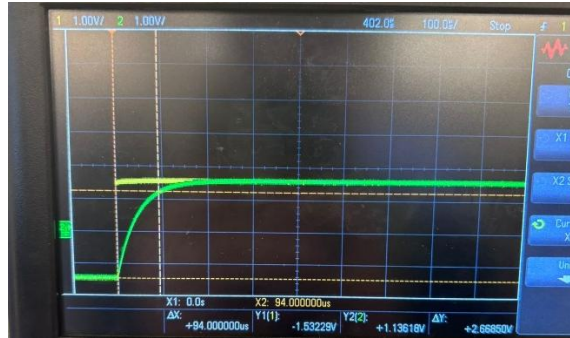
Measured Time Constants:

Condition	X1 (μ s)	X2 (μ s)	ΔX (μ s)
Button Up (R + 3.3k Ω)	-4	152	156
Button Held (R only)	0	94	94

- Oscilloscope readings



↑ BUTTON UP (R+3.3K Ω) ↑



↑ 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

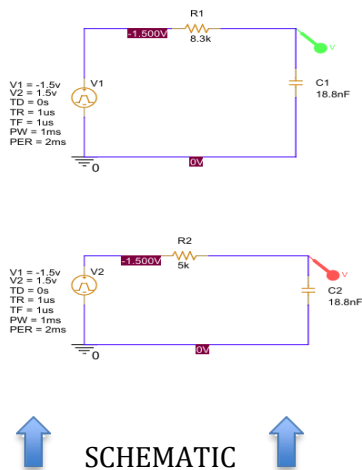
Milestone 6

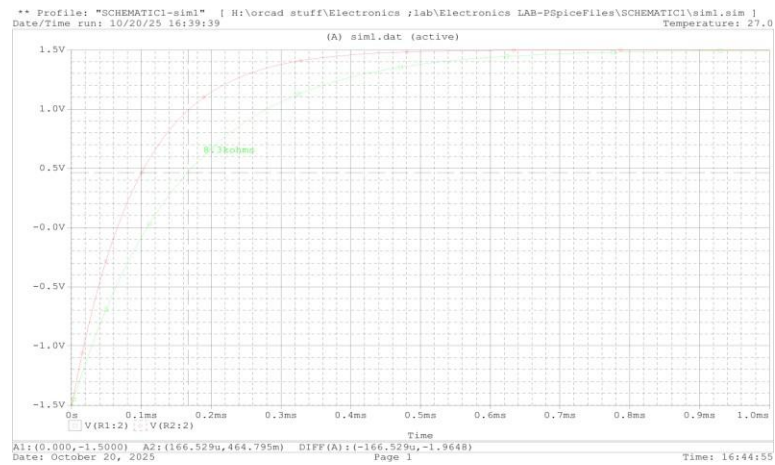
Circuit: RC network driven by VPULSE.

Parameters: R1=8.3k Ω , R2=5k Ω , C=18.8nF, Source=VPULSE(-1.5V to +1.5V, 500Hz, TR=1 μ s).

Simulation setup: Transient 6ms, max step 1 μ s.

- Results and schematic





↑ SIMULATION PSPICE ↑

Case	R (k Ω)	Simulated τ (μ s)	Experimental τ (μ s)
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 $\tau_1=156\mu$ s and $\tau_2=94\mu$ s gave $C=18.8$ nF and $R=5.0$ k Ω . Simulation results matched experimental data, confirming validity of the analysis.