

Lab 1 RC Circuit

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EE233 Circuit Theory

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Abstract—

I. INTRODUCTION

II. LAB PROCEDURE

III. EXPERIMENTAL PROCEDURE AND ANALYSIS

A. The RC Response to a DC Input

1) Square Wave Input Analysis:

We built the circuit in figure 1 with a resistor of $10\text{k}\Omega$ and a capacitor of $0.01\mu\text{F}$. We set the function generator to provide a square wave input with the period $T = 4.00000000\text{ms}$ and the voltage of $V_{pp} = 5\text{V}$ with offset $+2.5\text{V}$, which generates a square wave of maximum voltage 5V and minimum 0V .

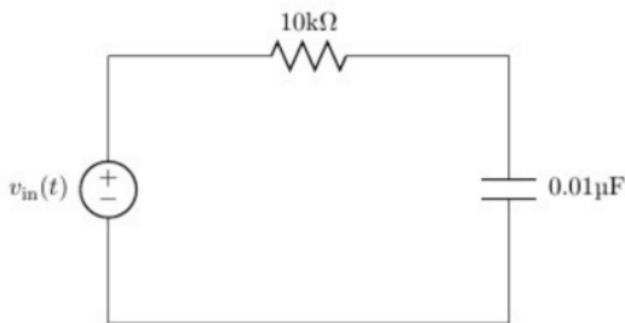


Fig. 1. RC circuit for square wave input analysis

We used channel 1 of the oscilloscope to verify the input and measured the output voltage of the capacitor by channel 2. Figure 2 is the screen output of two and half cycles.

Analysis #1:

The oscilloscope did display the same waveform plotted in Prelab#7. They are of the same shape, and both of their peaks and valleys reach the input waveform. Meanwhile, no obvious difference is found.

Using the *Cursor* menu, we recorded the period T , as well as the range of the output signal. Then we measured the time value of the 10%, 90%, and 50% point of V_{out} . The results are shown in table I.

Analysis #2:

After calculating the rise time, fall time, and delay time of the RC circuit, we got table II

2) Time Constant Measurement:

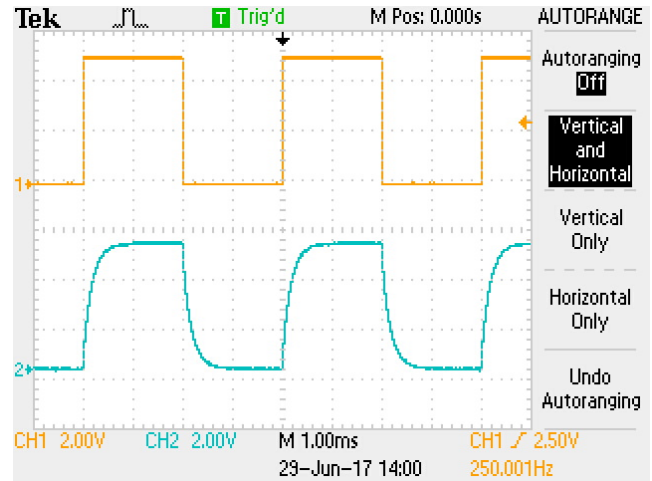


Fig. 2. The waveform of input and measure

TABLE I
MEASUREMENTS OF THE OUTPUT SIGNAL

name	value
period	4.000ms
max voltage	5.120V
min voltage	0.000V
time of 10% V_{out} (LH)	16.0 μs
time of 90% V_{out} (LH)	364 μs
time of 50% V_{out} (LH)	116 μs
time of 10% V_{out} (HL)	?? μs
time of 90% V_{out} (HL)	?? μs
time of 50% V_{out} (HL)	?? μs

TABLE II
MEASUREMENTS OF THE OUTPUT SIGNAL

name	actual value	theoretical value	PE
rise time	348 μs	220 μs	58.2%
fall time	?? μs	220 μs	??%
delay time (LH)	116 μs	69 μs	68.1%
delay time (HL)	?? μs	69 μs	??%

a) Analysis 1:

After we connected the circuit in Graph 4.1.1 in the lab instruction, we detected a waveform on our oscilloscope. To calculate its time constant accurately, we need as many data as possible. According to the instruction, we recorded 10 points separately for the original circuit, two-stage and three-stage. When we were selecting our testing points, we tried to pick more where the voltage rose(or fell) more rapidly with time. Also, we noticed that the measurements were not stable on the oscilloscope if its value was too small, so we paused the

screen on random to record a relatively accurate number.

When we were measuring the voltages and their according time, we used the Cursor whose type was time and took Channel 2 as its source. We settle one of the cursor at start point of a rising or falling action, and moved the other cursor slightly. We also scaled the width of the waveform to get a more accurate move.

Our recordings for the original circuit are shown in the table below.

No	Voltage(V)	time(ms)
1	0.512	16.0
2	0.880	32.0
3	1.20	44.0
4	1.52	60.0
5	1.92	80.0
6	2.28	100
7	2.56	116
8	2.60	124
9	3.68	216
10	4.61	364

b) *Experimental Results:* Then we apply the data in Excel, we get a plot3:

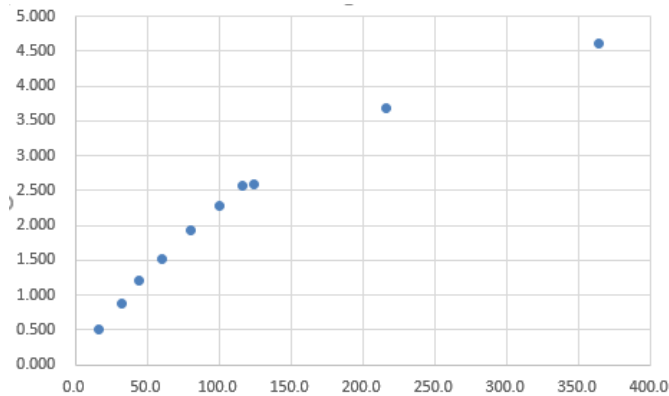


Fig. 3. plot V-t

As the instruction suggested, we made the x-axis(time) into logarithmic and plot again4 :

Then we fit a linear line to this plot, and we get a slope of 1.35. we get its inverse 0.74, which has an

B. The RC Response to a Sinusoidal Input

IV. CONCLUSIONS

V. APPENDIX

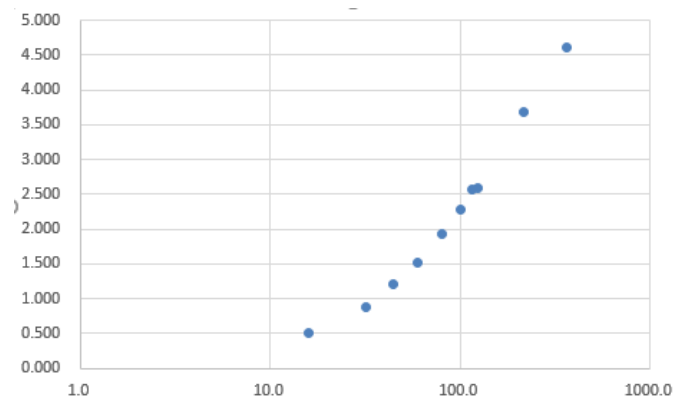


Fig. 4. plot V-ln(t)