

University of Wales Trinity Saint David

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Electrical Control Systems

ACHA4010

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6/4/25

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1 Task 3

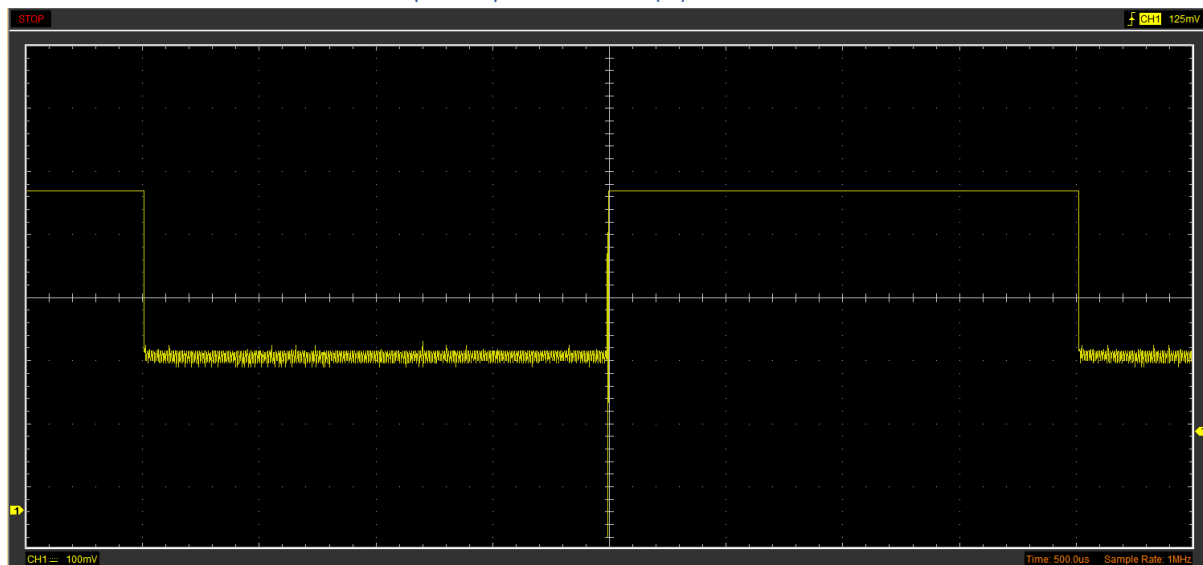
1.1 Scope Time Division Calculations (3)

Frequency = 250Hz

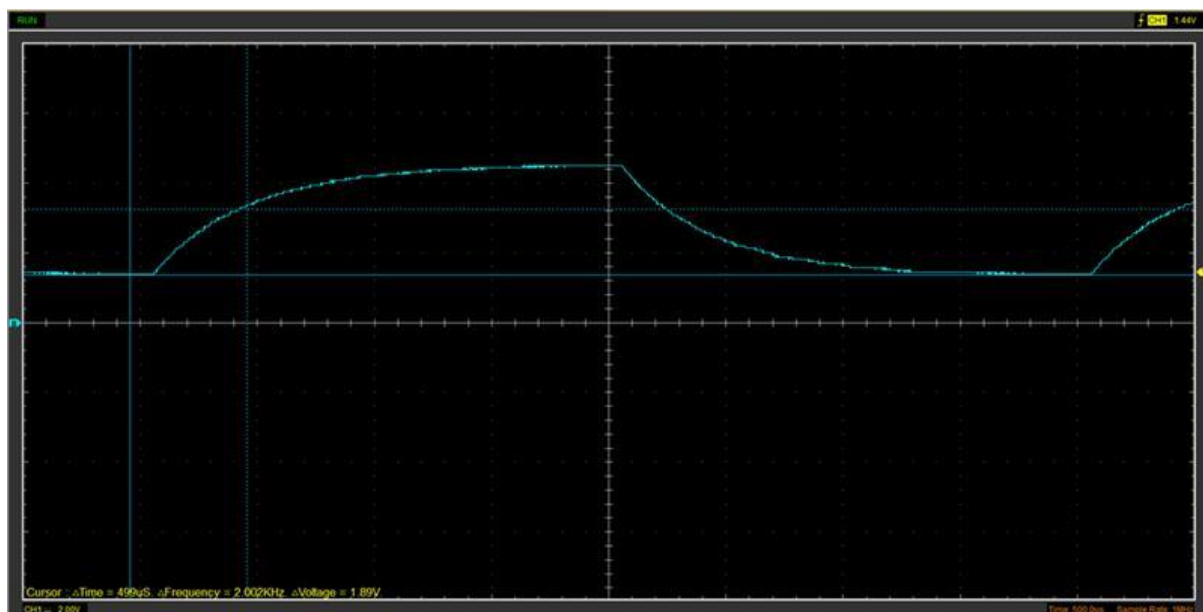
Period or $T = 1/\text{frequency} = 1/250 = 4\text{ms}$

$$T / \text{div} = \frac{T}{10} = \frac{4\text{ms}}{10} = 400\mu\text{s}/\text{div}$$

1.2 Function Generator output square wave (3)



1.3 Capacitor charge and discharge wave marked at correct points. (3)



1.4 Basic Capacitor Calculations (3)

$$C = \frac{t}{R} = \frac{500 \times 10^{-6}}{100} = 0.000005$$

1.5 Capacitor discharge table (2)

Time (s)	Voltage (V)	ln (V)	dy = y2 – y1 dy = ln(V)2-ln(V)1	dx = x2- x1 dx = Time2 – Time1	dy/dx
0.008	4.3922	1.47983	x	x	x
0.0086667	3.8902	1.358461	-0.121369	0.0006667	-182.06
0.0093333	3.5137	1.25667	-0.101791	0.0006666	-152.70
0.001000	3.2	1.163151	-0.093519	0.0006667	-140.28
0.00106667	2.8863	1.059975	-0.103176	0.0006667	-154.76
0.00113333	2.6353	0.968997	-0.090978	0.0006666	-136.48
0.001200	2.4471	0.894904	-0.074093	0.0006667	-111.14
0.00126667	2.2588	0.814834	-0.08007	0.0006667	-120.10
0.00133333	2.1333	0.75767	-0.057164	0.0006666	-85.76
0.001400	2.0078	0.69704	-0.06063	0.0006667	-90.94

1.6 Plot log(V) Gradient (2)

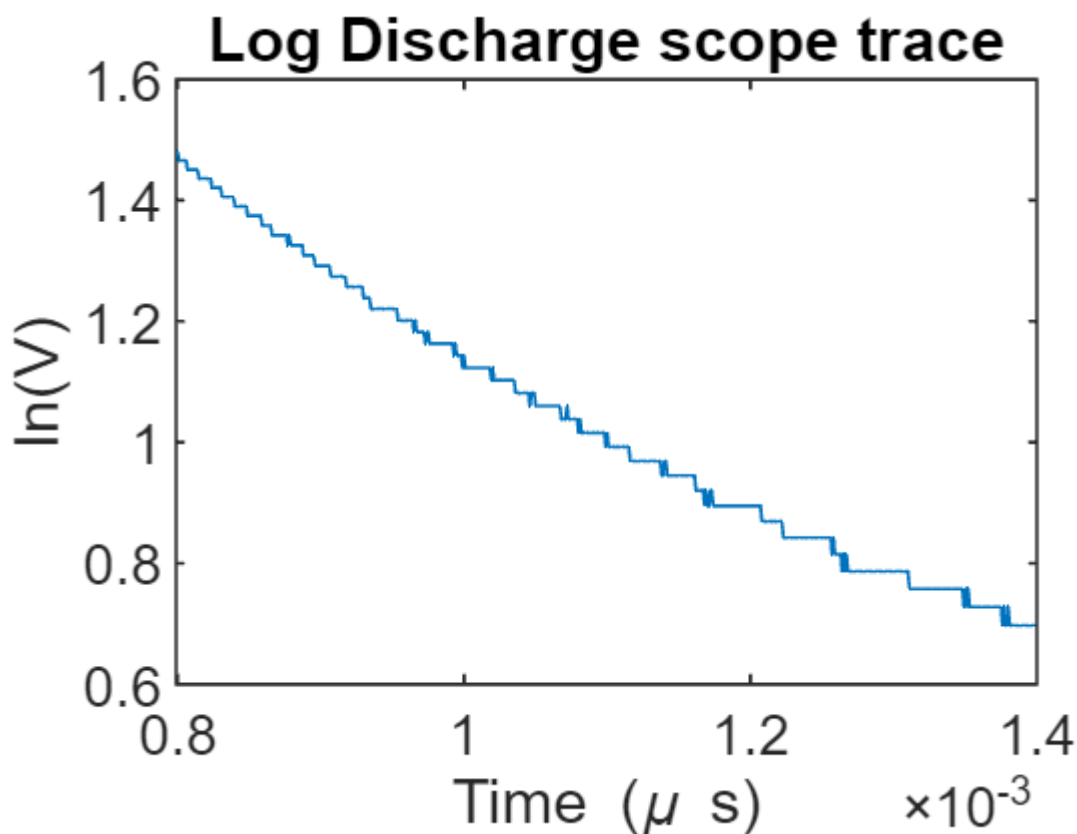


Figure 1 Gradient Data = -1.3047e+03

1.7 Gradient Calculations and Compare(4)

1.7.1 Gradient Calculations

A gradient taken from a linear fit trendline

$$M = -1030.3$$

$$c = \frac{1}{\frac{1030.3}{1000}} = 0.971\mu F$$

Closer m Calculation is =-1305

$$C = \frac{1}{R \times \text{gradient}} = \frac{1}{1000 \times (-1305)} = \frac{1}{130500} = 0.766\mu F$$

1.7.2 Comparison table

	Capacitance	Delta	Percentage difference
Actual	1 μF	x	X
Marker Calculation	5uF	4uF	400%
Gradient Calculation	0.767uF	0.233uF	23.7%

1.8 Capacitor Uses (5)

Capacitors have many uses in an automotive environment, in motorsport they can be used in many systems specifically in efficiency, such as use in a regenerative braking system as well as harvesting energy from the suspension system, as it stores and transfers the energy kinetic and thermal back to the battery (Teasdale, 2024). Capacitors are also used in high end sound systems to assist in the delivery of instant bursts of power during peak demand (NoName, 2020).

There are many uses for capacitors in electric vehicles such as; a backup system for short power outages, reducing strain on the battery during sudden power demands and even load distribution, this invertedly also enhances battery lifespan and health. They can also be used for energy storage on electronic turbochargers, reducing turbo lag.

Capacitors are also used in the wireless charging to help facilitate efficient energy transfer (Bai, 2020). They are also used as a smoothing device for the cars motor.

1.9 Inaccuracies Question (4)

There are many causes for inaccuracy when using devices such as the hantek scope and the breadboard its tolerances, as well as the quality of the breadboard circuit and connection to the scope. The components also need to be calibrated often so a lack of this will also throw results off. Human error can also cause some inaccuracies effecting the reading of the data as well as processing it.

A poorly compensated probe causes two types of measurement inaccuracies. One is incorrect amplitudes even at low frequencies, the second is distorted wave forms, such as changes in the rise and fall times. These inaccuracies increase with increasing frequency (Schwarz, n.d.).

It is important to use a probe with as small as an input capacitance as possible to reduce disturbance or loading.

2 Bibliography

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