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Electronic Circuits Testing and Applications

Electrical Control System ACHA4010

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1 Task 3

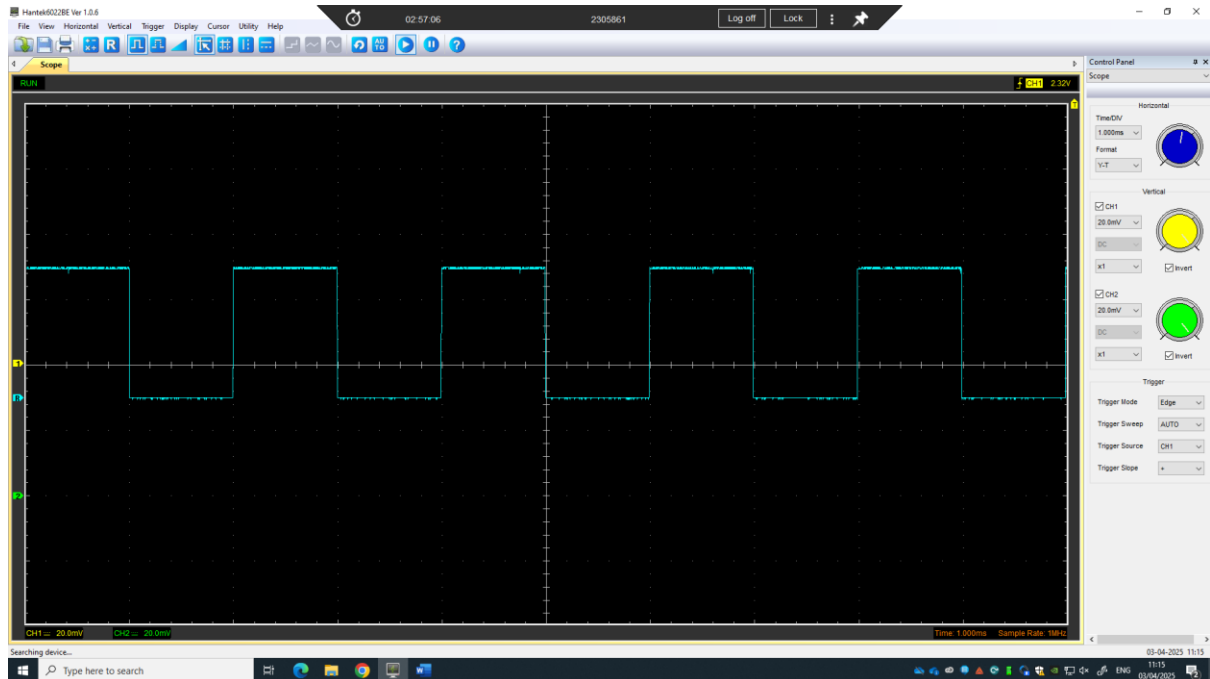
1.1 Scope Time Division Calculations (3)

$$F = 1/\text{period}(t)$$

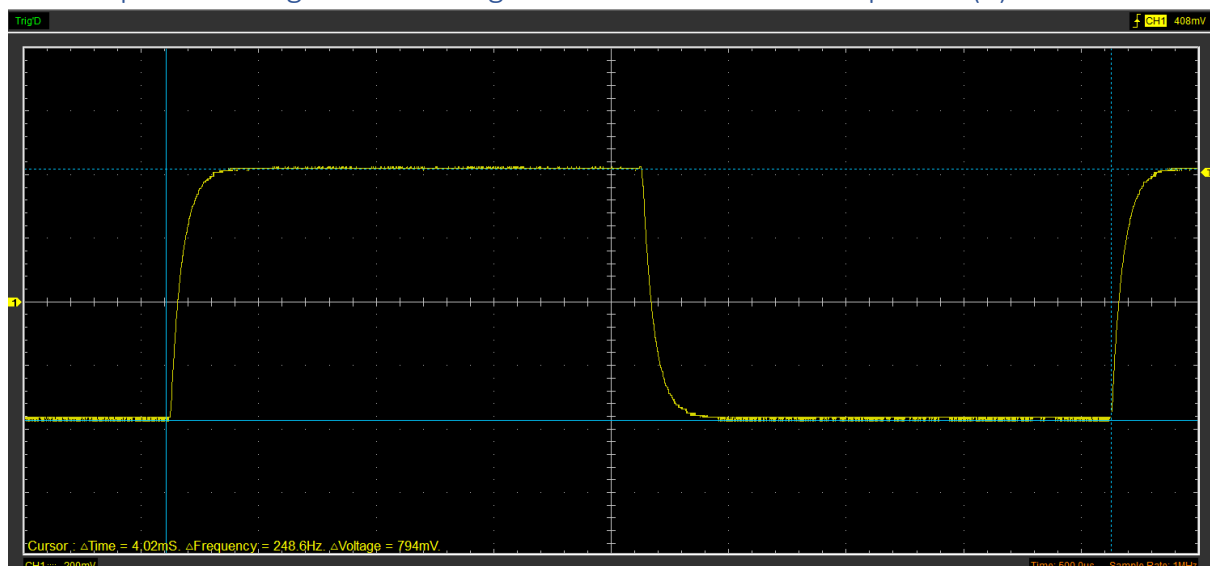
$$\text{Period}(t) = 1/f$$

$$\text{DivNumberTime} = 10$$

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)

$$\text{Range of voltage} = 1.96\text{V}$$

$$\text{Time Constant} = \text{Range Voltage} * 0.632 = 1.23872\text{V}$$

Find value of time constant at 1.23872V

Time constant at 1.23872V = 102 μ S

Capacitance = Time Constant/Resistance

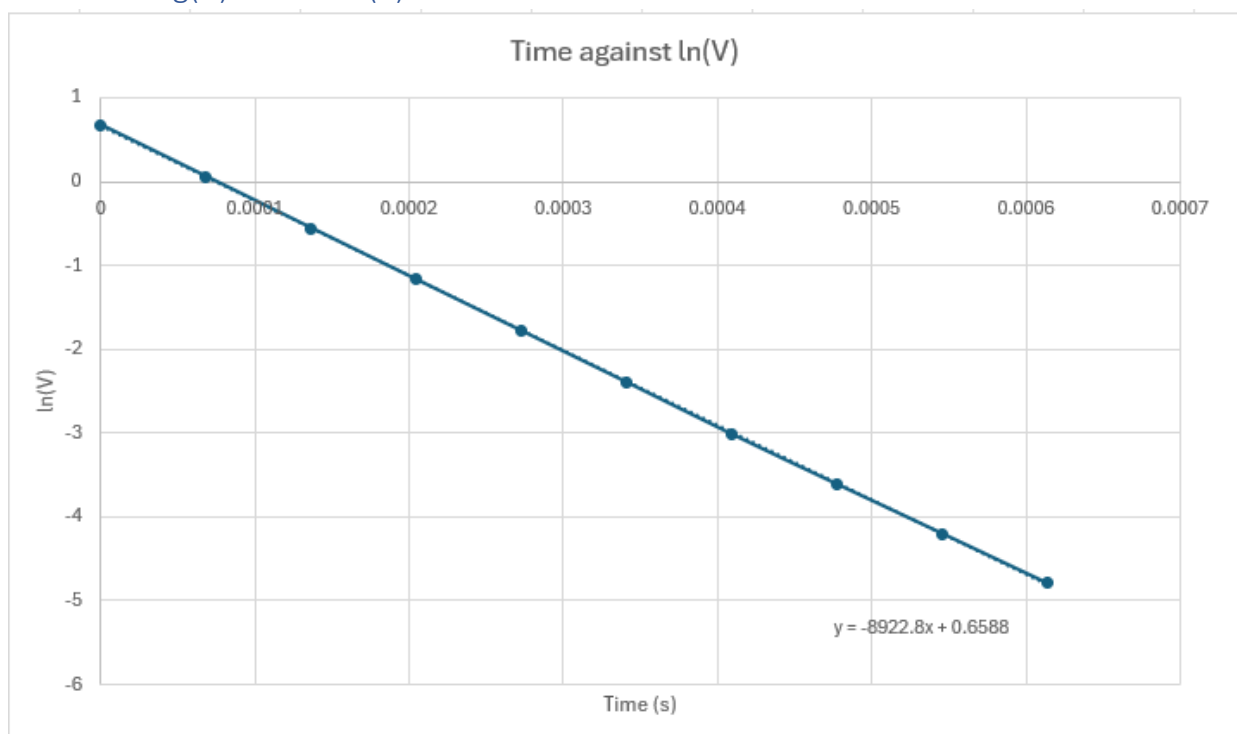
Capacitance = $102 \times 10^{-6} / 100$

Capacitance = 1.02×10^{-6} Farads = 1.02 μ F

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	1.96	0.672944	x	x	x
0.0000682	1.06	0.058269	-0.61468	0.0000682	-9012.84
0.0001364	0.573	-0.55687	-0.61514	0.0000682	-9019.63
0.0002046	0.31	-1.17118	-0.61431	0.0000682	-9007.53
0.0002728	0.168	-1.78379	-0.61261	0.0000682	-8982.53
0.000341	0.091	-2.3969	-0.6131	0.0000682	-8989.8
0.0004092	0.049	-3.01593	-0.61904	0.0000682	-9076.82
0.0004774	0.027	-3.61192	-0.59598	0.0000682	-8738.76
0.0005456	0.015	-4.19971	-0.58779	0.0000682	-8618.57
0.0006138	0.0083	-4.7915	-0.59179	0.0000682	-8677.34

1.6 Plot log(V) Gradient (2)



1.7 Gradient Calculations and Compare(4)

1.7.1 Gradient Calculations

$$C = \frac{1}{8922.8 \times 100} = 1.121 \times 10^{-6} \text{F} = 1.121 \mu\text{F}$$

1.7.2 Comparison table

	Capacitance	Delta	Percentage difference
Actual	1 μF	x	X
Marker Calculation	1.02 μF	0.02	2%
Gradient Calculation	1.121 μF	0.121	12.1%

1.8 Capacitor Uses (5)

- **Energy storage** – It can store energy and is used as a temporary battery in case of power outages or batteries being changed. It is also used in car audio systems. (Easby Electronics, 2020)
- **Signal Decoupling** – Located between the power supply and ground, decoupling capacitors absorb electrical noise produced by circuit elements to protect and reduce the impact on sensitive microchips in the circuit. (Easby Electronics, 2020)
- **Signal Coupling** – Couple a section of the circuit to another where a DC current can damage the device, e.g. loudspeaker applications. (Easby Electronics, 2020)
- **Power Factor Correction** – Improves energy efficiency. Capacitors are switched in and out to counteract inefficient effects from inductive loading devices like electric motors and transmission lines. (Easby Electronics, 2020)
- **Motor Starting** – Used in motor starters, allows an electric motor to be cycled on and off and increase the motor's starting torque. Connected to the motor windings. (Davis *et al.*, 2021)
- **Power Conditioning** – Provide a smooth current, allowing consistent energy levels. Bypasses AC currents, allowing it to work as a reserve for a DC power source. (Easby Electronics, 2020)
- **Sensing** – Capacitors are used as sensors to detect changes such as mechanical strain, humidity fuel levels and loss or gain of capacitance. Used in motion sensors, too. (Easby Electronics, 2020)
- **Oscillators** – Used in radio systems, the capacitor charges and discharges at intervals until the frequency matches a nearby broadcast. (Easby Electronics, 2020)
- **Pulsed Power** – Capacitor banks utilise capacitors to provide pulsed power for applications such as pulsed lasers, Marx generators, particle accelerators and electromagnetic forming.

(Easby Electronics, 2020)

- Surge Suppression – Absorbs excess energy from surges and shields equipment from damage. (HILKAR, 2025)

1.9 Inaccuracies Question (4)

There may be inaccuracies from the equipment. An example is the function generator. Some groups had to change their function generator due to reading a different result compared to the example and the majority. Another reason for inaccuracies is human error. When marking the scope wave graph, everyone will receive different results due to where the cursor is placed. The sensitivity of the mouse can affect this too, as it is difficult to pinpoint the exact point on the graph if the sensitivity isn't lowered affecting the reading accuracy furthermore. Screen resolution can be a factor in accuracy, too. When calculating values, rounding up results can build up and affect the table and graph results.

External factors such as temperature can affect the performance and capacity of the capacitor. (TDK, 2025). Parasitic capacitance and stray inductance may also affect the reading, changing the reading output. These effects are unavoidable. (Farnell, 2025). Loose wiring has a significant effect and produces increased resistance and voltage drops in the circuit, therefore massively affecting the output reading. (IRISS, 2024).

2 References

Davis, J. et al. (2021) *Start and Run Capacitors for Electric Motors - Alabama Cooperative Extension System, extension*. Available at: <https://www.aces.edu/blog/topics/farming/start-and-run-capacitors-for-electric-motors/> (Accessed: April 6, 2025).

Easby Electronics (2020) *A Guide to the Applications of Capacitors* %, Easby Electronics. Available at: <https://easby.com/a-guide-to-the-applications-of-capacitors-easby-electronics/> (Accessed: April 6, 2025).

Farnell (2025) *Parasitic Capacitance definition* | Farnell UK, Farnell. Available at: <https://uk.farnell.com/parasitic-capacitance-definition> (Accessed: April 6, 2025).

HILKAR (2025) *SURGE CAPACITORS*, HILKAR. Available at: <https://hilkar.com/surgecapacitors.html> (Accessed: April 6, 2025).

IRISS (2024) *Detecting Loose Electrical Connections* | Blog | IRISS, IRISS. Available at: <https://iriss.com/discover/blog/detecting-elusive-loose-electrical-connections/> (Accessed: April 6, 2025).

TDK (2025) *How much change can I expect in capacitance with temperature change of an capacitor (MLCC with dipped radial lead)?* | FAQ | TDK Product Center, TDK. Available at: <https://product.tdk.com/en/contact/faq/capacitors-0148.html> (Accessed: April 6, 2025).