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## Electronics Circuits Testing and applications.

Electrical Control Systems

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## 1 Task 3

### 1.1 Scope Time Division Calculations (3)

$$\text{Time Constant}(\tau) = \frac{1}{\text{frequency}(f)}$$

$$\tau = \frac{1}{250} = 4 \times 10^{-3} \text{ s}$$

$$\tau_{div} = \frac{1}{n_{div}}$$

$$\frac{4 \times 10^{-3}}{10} = 4 \times 10^{-4} \text{ s}$$

### 1.2 Function Generator output square wave (3)

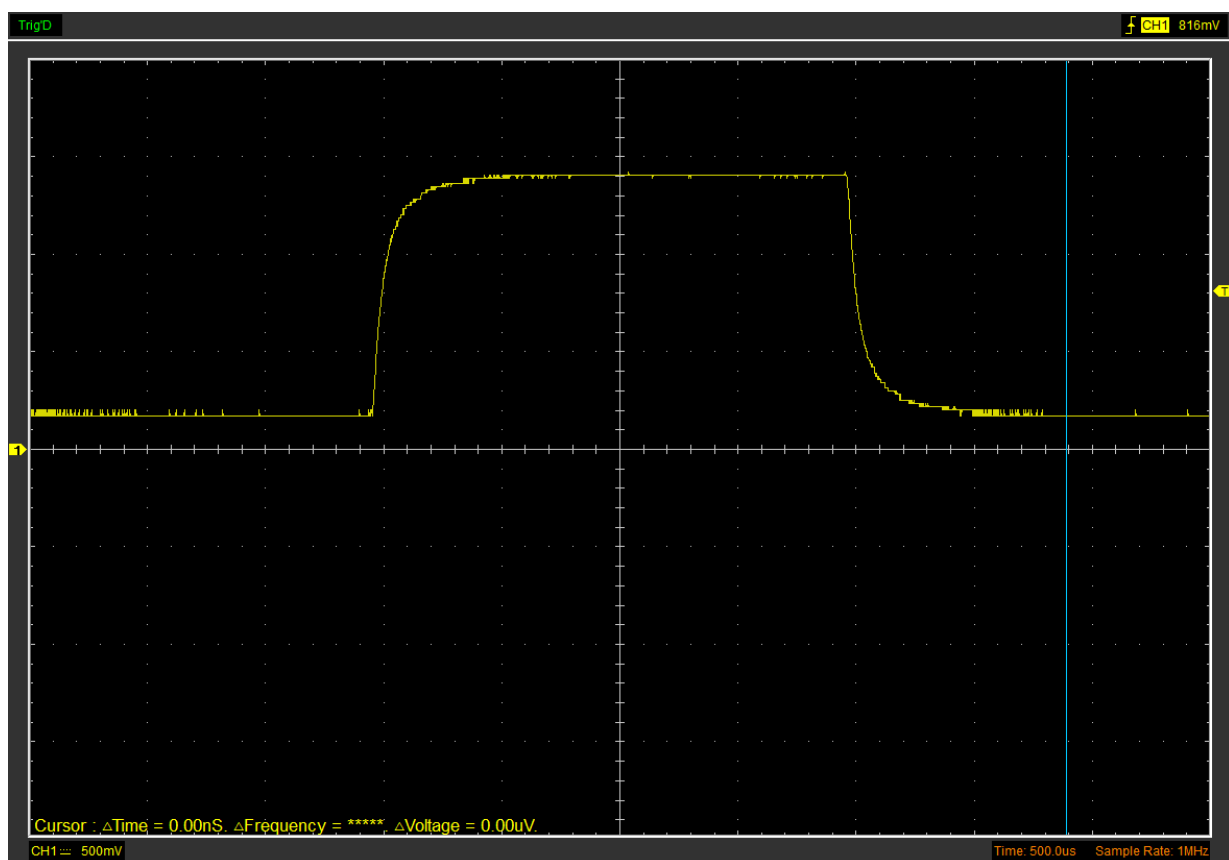


Figure 1: Output Wave

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

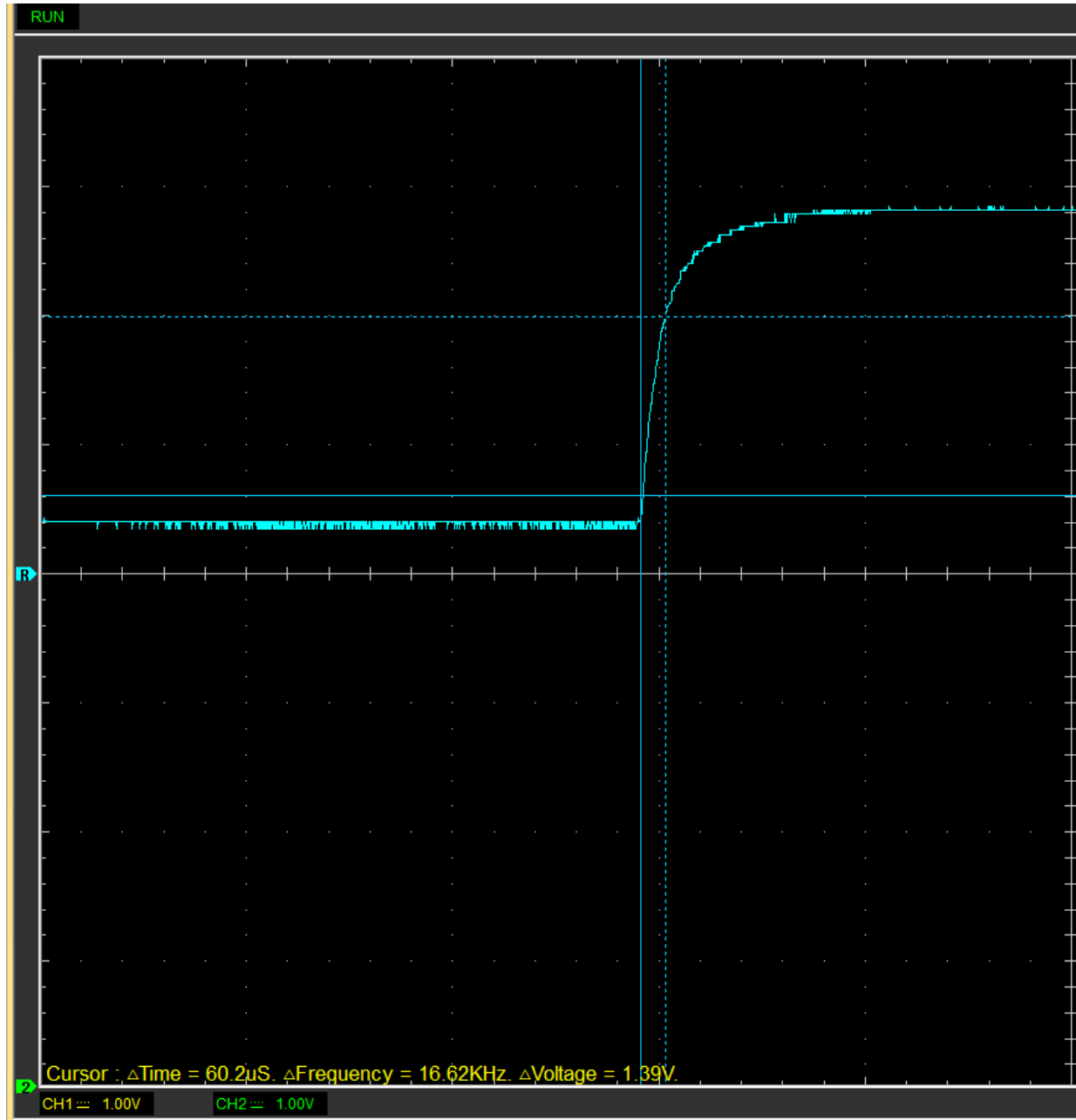


Figure 2: Marked Capacitor Charge Wave.

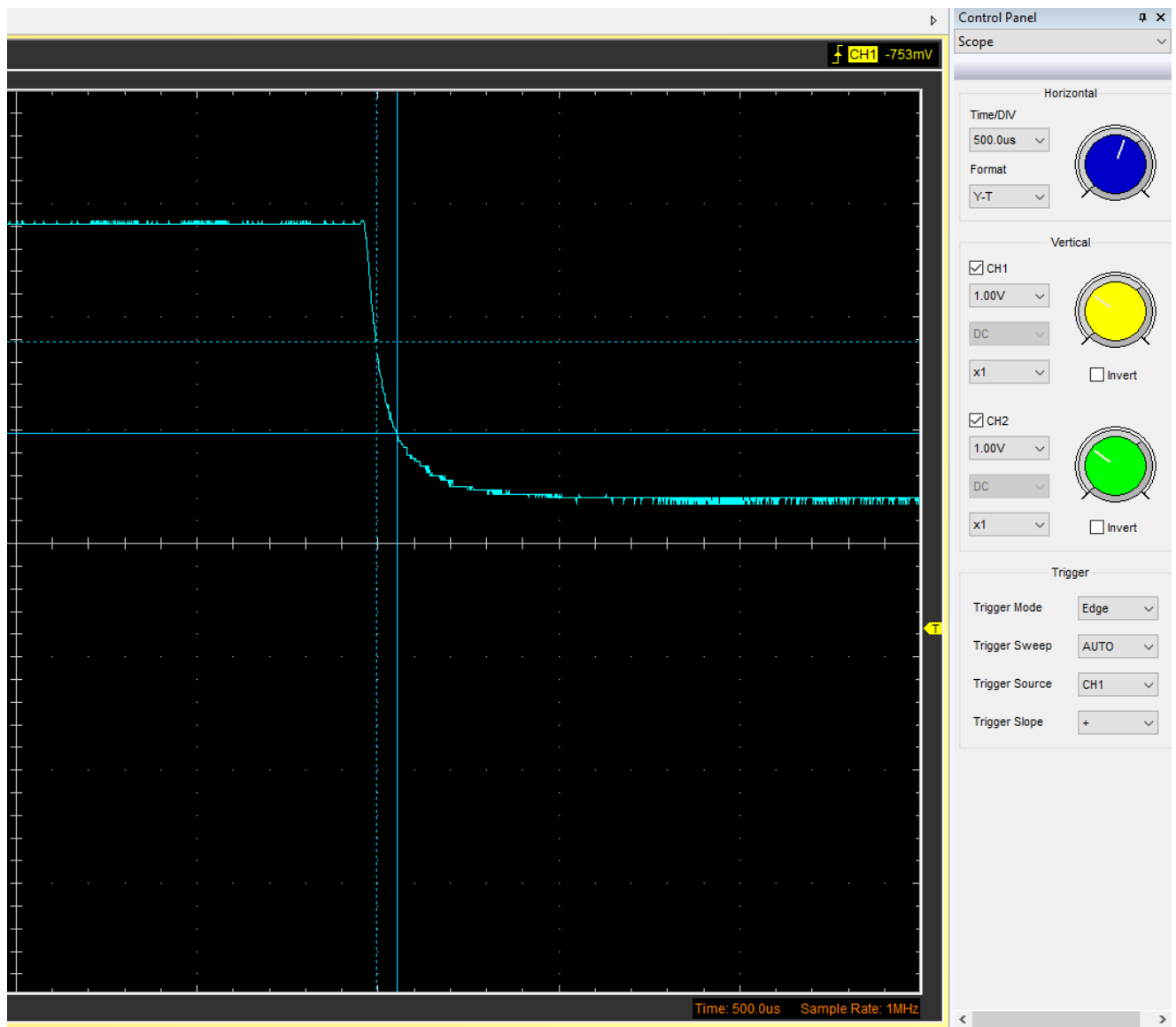


Figure 3: Marked Capacitor Discharge Wave.

#### 1.4 Basic Capacitor Calculations (3)

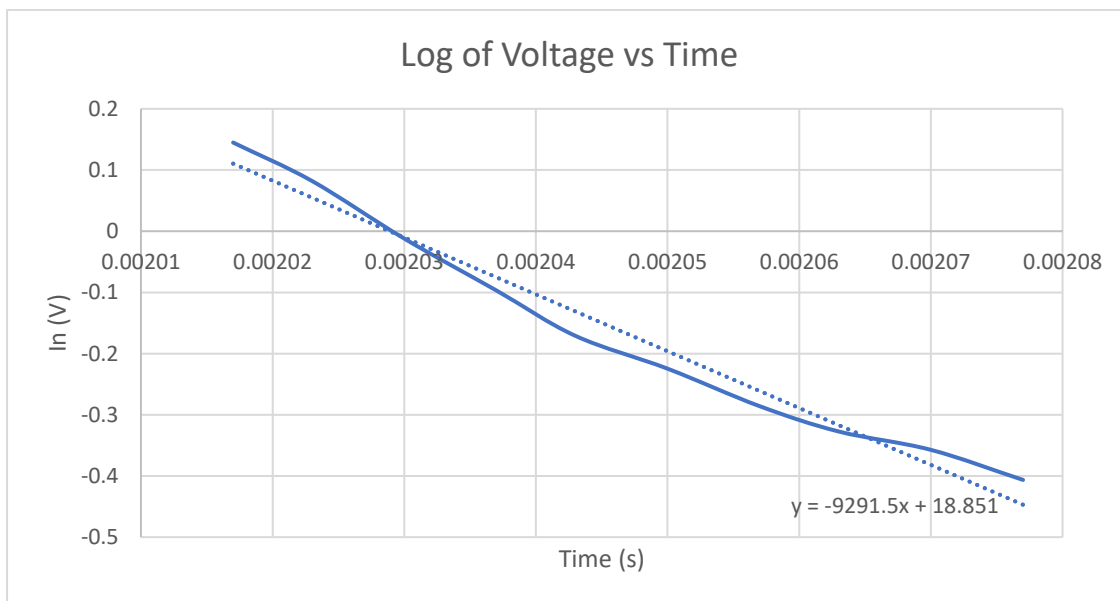
$$\text{Capacitance } (C) = \frac{\text{Time Constant } (\tau)}{\text{Resistance } (R)}$$

$$C = \frac{60.2}{100} = 0.602\mu F$$

### 1.5 Capacitor discharge table (2)

| Time (s) | Voltage (V) | ln (V)      | dy = y2 – y1<br>dy = ln(V)2-ln(V)1 | dx = x2- x1<br>dx = Time2 – Time1 | dy/dx       |
|----------|-------------|-------------|------------------------------------|-----------------------------------|-------------|
| 0.002017 | 1.3961      | 0.14491653  | x                                  | x                                 | x           |
| 0.002023 | 1.2078      | 0.08199503  | -0.062921502                       | 0.000006                          | -10486.917  |
| 0.00203  | 0.9725      | -0.01211039 | -0.094105415                       | 0.000007                          | -13443.6308 |
| 0.002037 | 0.8         | -0.09691001 | -0.084799623                       | 0.000007                          | -12114.2319 |
| 0.002043 | 0.6745      | -0.17101805 | -0.074108033                       | 0.000006                          | -12351.3388 |
| 0.00205  | 0.5961      | -0.22468088 | -0.053662832                       | 0.000007                          | -7666.11888 |
| 0.002057 | 0.5176      | -0.28600573 | -0.061324854                       | 0.000007                          | -8760.69345 |
| 0.002063 | 0.4706      | -0.32734808 | -0.041342345                       | 0.000006                          | -6890.3908  |
| 0.00207  | 0.4392      | -0.35733767 | -0.029989591                       | 0.000007                          | -4284.22734 |
| 0.002077 | 0.3922      | -0.40649241 | -0.049154742                       | 0.000007                          | -7022.10602 |

### 1.6 Plot log(V) Gradient (2)



### 1.7 Gradient Calculations and Compare(4)

#### 1.7.1 Gradient Calculations

$$\frac{1}{-\text{Gradient Of Graph}}$$

$$\frac{1}{-(-9291.5)} = 1.08 \times 10^{-4}$$

$$\frac{1.08 \times 10^{-4}}{100} = 1.08 \times 10^{-6}$$

### 1.7.2 Comparison table

|                      | Capacitance         | Delta  | Percentage difference |
|----------------------|---------------------|--------|-----------------------|
| Actual               | 1 $\mu\text{F}$     | x      | X                     |
| Marker Calculation   | 0.602 $\mu\text{F}$ | -0.398 | -39.8%                |
| Gradient Calculation | 1.08 $\mu\text{F}$  | 0.08   | 8%                    |

## 1.8 Capacitor Uses (5)

1. Blind spot detection (Roos, G. (2019)).
2. Adaptive Cruise Control (Roos, G. (2019)).
3. Secondary power lines for electronic applications, such as headlights and integrated starter generators (Roos, G. (2019)).
4. Alarm systems (Roos, G. (2019)).
5. Emergency Braking assistance (Roos, G. (2019)).
6. Used in Electromagnetic Capacity (EMC) Filters (Roos, G. (2019)).
7. Used in Anti-noise measures (Roos, G. (2019)).
8. Improve Charging Efficiency of Electric Vehicles (Cosmo films (2023)).
9. They convert high voltages from the battery to lower voltages for use in vehicle components (Cosmo films (2023)).
10. Used in Electrical control Units for fans and temperature sensors.

## 1.9 Inaccuracies Question (4)

- . Old equipment was used, this equipment could be faulty.
- . Multimeter could have been set in the wrong range (QuarkTwin (2023)).
- . Capacitor could have overheated during testing or during previous uses prior to this test (QuarkTwin (2023)).
- . Capacitors can lose capacitance over time as they degrade which would affect the readings (QuarkTwin (2023)).

## 2 References

1. Cosmo Films. (2023). The Role of Capacitor Films in the Automotive Sector. [online] Available at: <https://www.cosmofilms.com/blog/the-role-of-capacitor-films-in-the-automotive-sector>
2. QuarkTwin (2023). Capacitor Testing From Beginner To Master. [online] Quarktwin Electronic. Available at: <https://www.quarktwin.com/blogs/capacitor/capacitor-testing-from-beginner-to-master/98>
3. Roos, G. (2019). Top 10 capacitors for automotive applications - Electronic Products. [online] Electronic Products. Available at: <https://www.electronicproducts.com/top-10-capacitors-for-automotive-applications/>