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# Electronic Circuits Testing and Applications

Electrical Control Systems

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06/04/2025

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## 1 Task 3

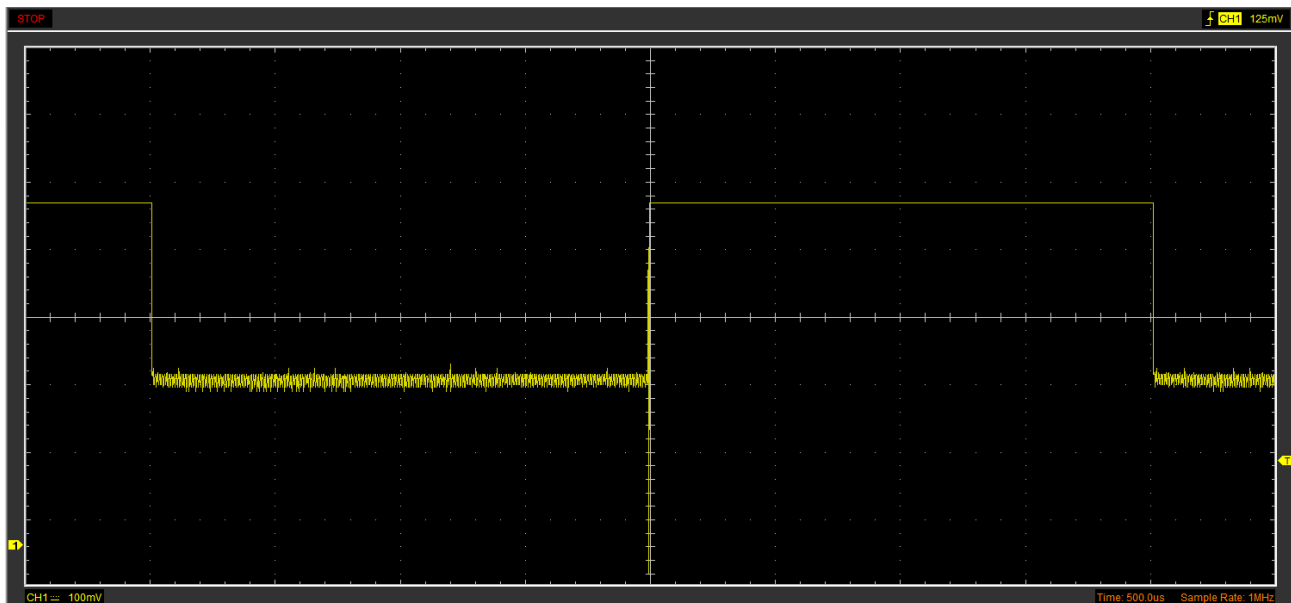
### 1.1 Scope Time Division Calculations (3)

Frequency = 250Hz

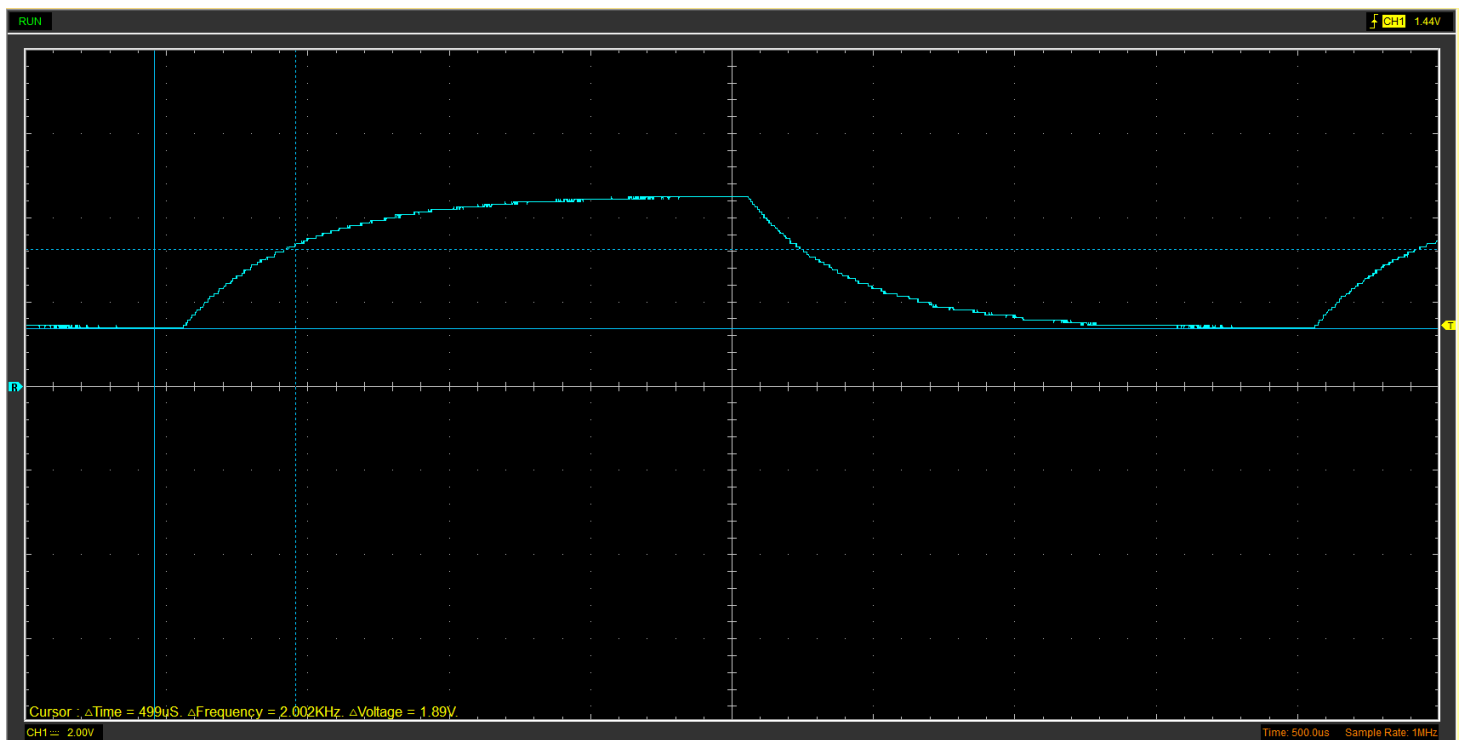
Period or  $T = 1/\text{frequency} = 1/250 = 4\text{ms}$

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

### 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)

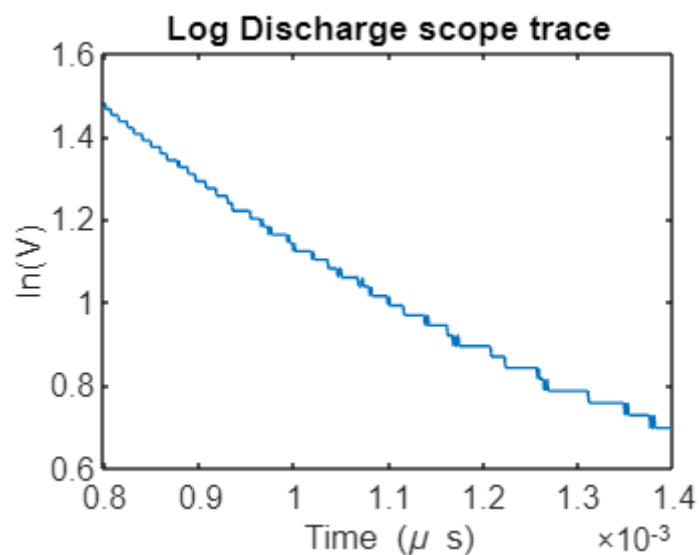
Using 500us at the 63.2% voltage point during the charging wave

$$C = \frac{t}{R} = \frac{500 * 10^{-6}}{100} = 5\mu F$$

### 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   |
|----------|-------------|----------|------------------------------------|-----------------------------------|---------|
| 0.008    | 4.3922      | 1.47983  | x                                  | x                                 | x       |
| 0.00866  | 3.8902      | 1.358461 | -0.121369                          | 0.0006667                         | -182.06 |
| 0.00933  | 3.5137      | 1.25667  | -0.101791                          | 0.0006667                         | -152.7  |
| 0.01     | 3.2         | 1.163151 | -0.093519                          | 0.0006667                         | -140.28 |
| 0.01067  | 2.8863      | 1.059975 | -0.103176                          | 0.0006667                         | -154.76 |
| 0.01133  | 2.6353      | 0.968997 | -0.090978                          | 0.0006667                         | -136.48 |
| 0.012    | 2.4471      | 0.894904 | -0.074093                          | 0.0006667                         | -111.14 |
| 0.01267  | 2.2588      | 0.814834 | -0.08007                           | 0.0006667                         | -120.10 |
| 0.01333  | 2.1333      | 0.75767  | -0.057164                          | 0.0006667                         | -85.76  |
| 0.014    | 2.0078      | 0.69704  | -0.06063                           | 0.0006667                         | -90.94  |

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



## 1.7 Gradient Calculations and Compare(4)

### 1.7.1 Gradient Calculations

The gradient of the Log Discharge scope trace graph is -1304.65107539294. the gradient will be rounded to -1304.65.

$$C = \frac{1}{R * gradient} = \frac{1}{1000 * (-1304.65)} = \frac{1}{130465} = 0.767 \mu F$$

Capacitance = 7.6649e-07 F

= 0.76649  $\mu$ F

Comparison table

|                      | Capacitance   | Delta          | Percentage difference |
|----------------------|---------------|----------------|-----------------------|
| Actual               | 1 $\mu$ F     | x              | X                     |
| Marker Calculation   | 5 $\mu$ F     | 4 $\mu$ F      | 400%                  |
| Gradient Calculation | 0.767 $\mu$ F | -0.233 $\mu$ f | 23.7%                 |

## 1.8 Capacitor Uses (5)

Capacitors have many uses in the world of automobiles and motorsports such as interior features like the A/C. They are also used for energy storage in Formula One (F1) to increase acceleration in the newer hybrid F1 cars similar for newer EVs for bursts of power for braking and acceleration. Capacitors are found all over newer cars with them being used in steering, braking and even seat height adjustment (Arrow 2018). Capacitors are used for electric turbochargers (Torchinsky, 2017). They are also seen in active suspension systems with Eaton being able to supply their students with power supercapacitors to be able to better their suspension (document. 2019). LED headlights are commonly enabled by capacitors especially with newer cars wanting to sport the much brighter lights. Throttle by wire is made better with capacitors as it helps block out any extra 'noise' for the signal through to the steering (Liang 2023)

## 1.9 Inaccuracies Question (4)

There are many factors that could have influenced the accuracy of the values between the measured and actual capacitance. The first possible inaccuracy is the human error for there could have been measurement inaccuracies in the oscilloscope measurement which relies on the marker placement for the data collection especially when identifying the 63.2% charge value.

The calibration of the measurement tools can have an effect on the data collection for without regular calibration accurate data measurement cannot be guaranteed (weishi 2024). Capacitors also can leak current which can be hard to register and will have an effect on any result even though it will only be a small inaccuracy (Quarktwain 2023). Temperature

and overheating can have a significant effect on the capacitor and then measurement of the data that will be collected if effected, however temperature will always have an effect on the final result as ambient temperatures will vary at different times and places. Noise and interference can have an effect on the capacitors ability to perform across different frequencies (McNeil 2023).

## 2 References

(Format to Harvard style as per handbook)

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