

University of Wales Trinity Saint David

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Vehicle Electronics Assignment

Vehicle Electronics ACHA4031

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18/04/2026

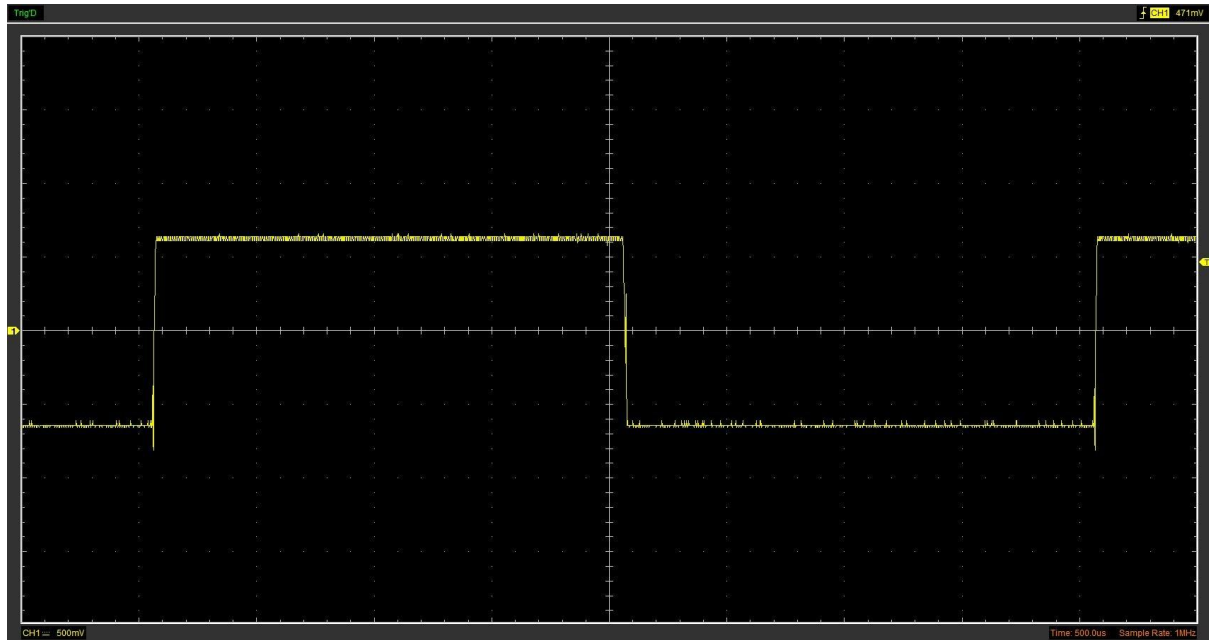
Contents

1	Task 3	1
1.1	Scope Time Division Calculations	1
1.2	Function Generator output square wave	1
1.3	Capacitor charge and discharge wave marked at correct points	1
1.4	Basic Capacitor Calculations	2
1.5	Capacitor discharge table	2
1.6	Plot $\log(V)$ Gradient	2
1.7	Gradient Calculations and Compare	2
1.7.1	Gradient Calculations	2
1.7.2	Comparison table	2
1.8	Capacitor Uses	2
1.9	Inaccuracies Question	3
1.10	Risk Question	3
2	References	4

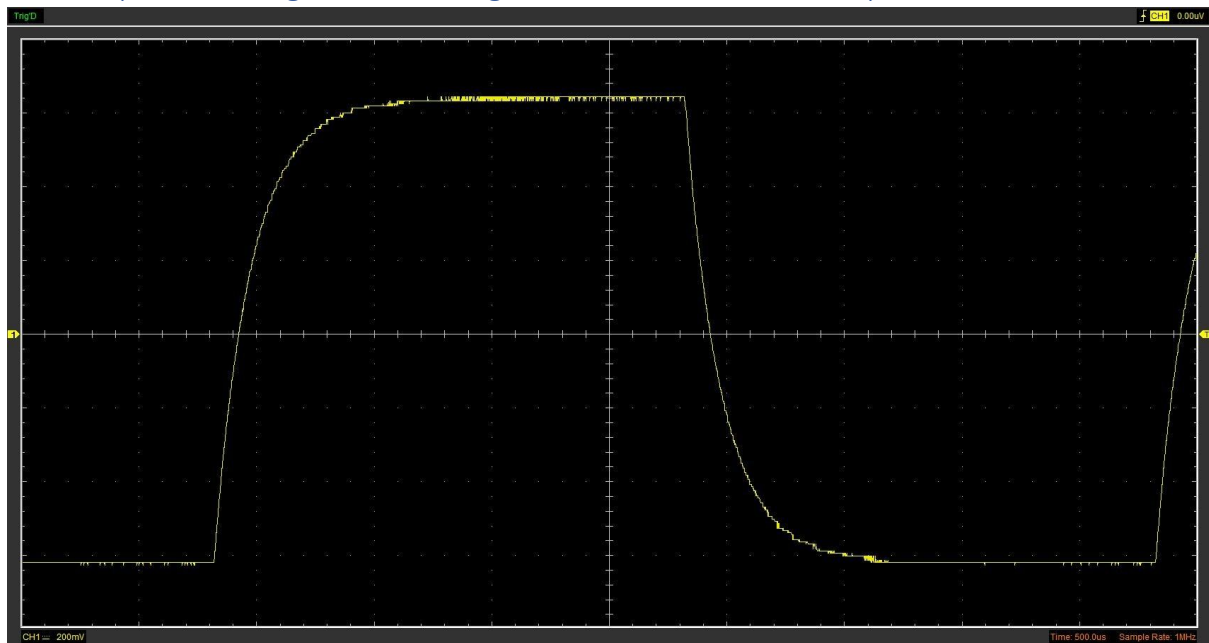
1 Task 3

1.1 Scope Time Division Calculations

1.2 Function Generator output square wave



1.3 Capacitor charge and discharge wave marked at correct points



1.4 Basic Capacitor Calculations

1.5 Capacitor discharge table

Time (s)	Voltage (V)	ln (V)	$dy = y_2 - y_1$ $dy = \ln(V)_2 - \ln(V)_1$	$dx = x_2 - x_1$ $dx = \text{Time}_2 - \text{Time}_1$	dy/dx
			x	x	x

1.6 Plot log(V) Gradient

1.7 Gradient Calculations and Compare

1.7.1 Gradient Calculations

1.7.2 Comparison table

	Capacitance	Delta	Percentage difference
Actual	1 μF	x	X
Marker Calculation			
Gradient Calculation			

1.8 Capacitor Uses

Capacitors are used in many different ways, as;

- ignition condensers, protecting the points in the distributor from arcing while the points are open.
- In car audio systems, helping to provide instant power spurts that the battery can't deliver quickly enough, during heavy bass in a music track.
- In regenerative braking to store electrical energy under braking and deploying it under acceleration to improve fuel efficiency. This would require the use of supercapacitors.
- To eliminate the battery on old kick start motorbikes to power lights and the ignition as well as to smooth out the ripple from the rectifier.
- To protect ECUs from electromagnetic interference and protect them from voltage spikes, which would otherwise harm the unit.
- In high RPM engines to store energy and deploy it to create the spark faster, as required at high RPM.
- To start an AC motor's rotation by creating a phase shift. Once up and running, the capacitors will help to maintain the torque.

- In power factor correction in industrial AC systems to improve efficiency and reduce costs by correcting the power factor from inductive devices such as 3 phase motors.
- In radios to match a specific frequency using variable capacitors.
- To protect circuit chips from voltage spikes caused by high-frequency noise.

1.9 Inaccuracies Question

Inaccuracies in measurements can be caused by many things. They can be caused by human error in setting up the equipment and in reading the equipment, especially where non-digital equipment is being used. They can be down to random errors or the environment, like temperature changes, for example. The instruments may not be well maintained or may have lost their calibration. There may be a poor connection or vibrations, Vitrek (2026).

In this case, given an oscilloscope was used, errors could be a result of the person performing the experiment reading the wrong scale or simply misreading it in general. There may have been a poor connection or an environmental change that could lead to unexpected results. Also, random errors can appear at any time, so could result in any discrepancies, MME (n.d.).

1.10 Risk Question

The risks of cyber attacks on vehicles can be mitigated by ensuring data and messages are encrypted and that critical systems are kept separate from non-critical ones, (Copperhill, 2025). Access should be controlled and external access should be limited. Any over the air updates should be verified and digitally signed before installation, while maintaining the ability to roll back to protect from update failures. By continuously monitoring the system for vulnerabilities and creating and deploying patches to fix security issues quickly, once they're discovered. Having a means of reporting incidents helps to improve the ability to discover these issues.

At the time of writing, there have been no major cyber-attacks like there have been in other areas of industry, such as ransomware, but according to NTT DATA (2021), it's only a matter of time before such attacks take place.

It would also solve any risk of cyber-attack if all CANBUS systems were removed, replaced by simple, independent devices with no access to the car itself on the internet directly. Cyber attack is a new issue for cars and did not affect cars in the 80s, 90s or even in the early 2000s. Given these systems produce such security threats it poses the question, are they really worth it? Given that a cyber-attack could pose a risk to the driver, occupants and other road users, while the benefits are only functionality, the author does not believe so. Anyone being injured or even potentially killed is not worth some mere functionality. Cars in the 90s and early 2000s worked just fine without it and people were arguably better drivers for it.

2 References

Copperhill. (2025). Secure Your CAN-Bus: Implementing ISO/SAE 21434 in Embedded Systems. [online] Available at: <https://copperhilltech.com/blog/secure-your-canbus-implementing-isosae-21434-in-embedded-systems/> [Accessed 19 Apr. 2026].

Automotive Cybersecurity An End-to-End Automotive Cybersecurity Solution Combining NTT DATA's Intrusion Detection System for CAN Bus with its State-of-the-Art Vehicle-Security Operation Center. (2021). Available at: <https://www.nttdata.com.cn/pdf/2021-EN-Wp-Automotive-Cybersecurity-Web.pdf> [Accessed 19 Apr. 2026].

Vitrek, M.T.I. (2026). Measurement Errors. [online] Vitrek. Available at: <https://vitrek.com/mti-instruments/knowledge-center/measurement-errors/> [Accessed 19 Apr. 2026].

MME. (n.d.). Limitations and Errors in Measurements Worksheets, Questions and Revision. [online] Available at: <https://mmerevise.co.uk/a-level-physics-revision/limitations-and-errors-in-measurements/> [Accessed 19 Apr. 2026].