



University of Wales Trinity Saint David
Wales Institute of Science and Art

Electrical Circuit Testing and Applications
ACHA 4003

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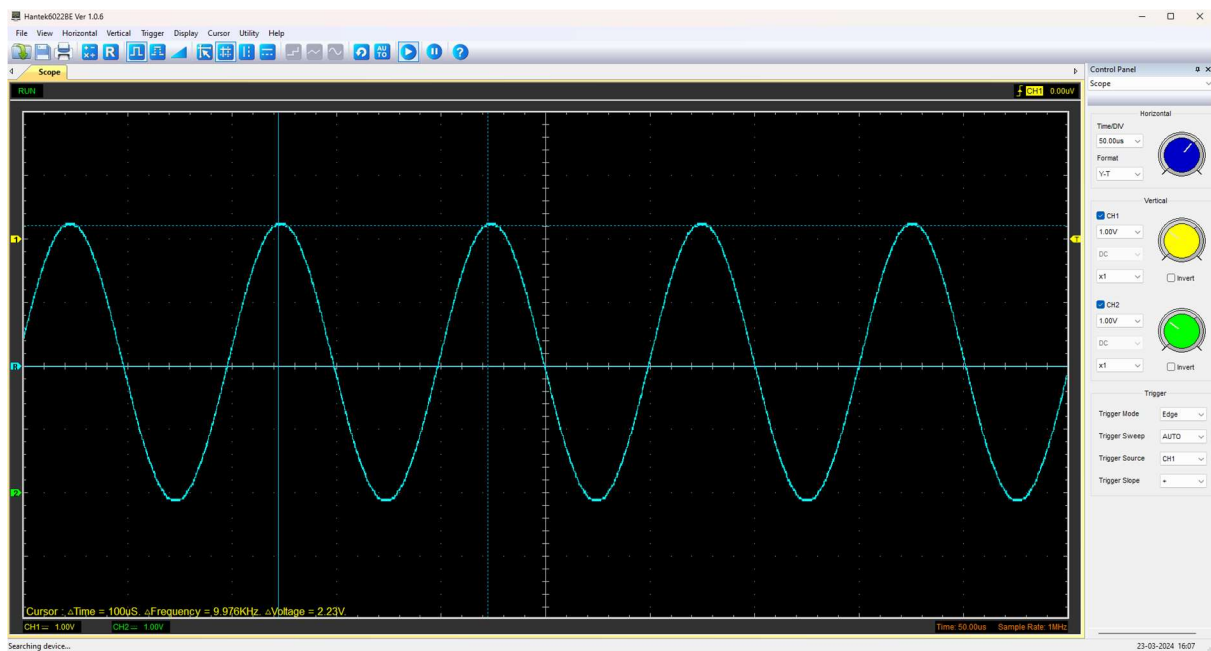
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Task 2

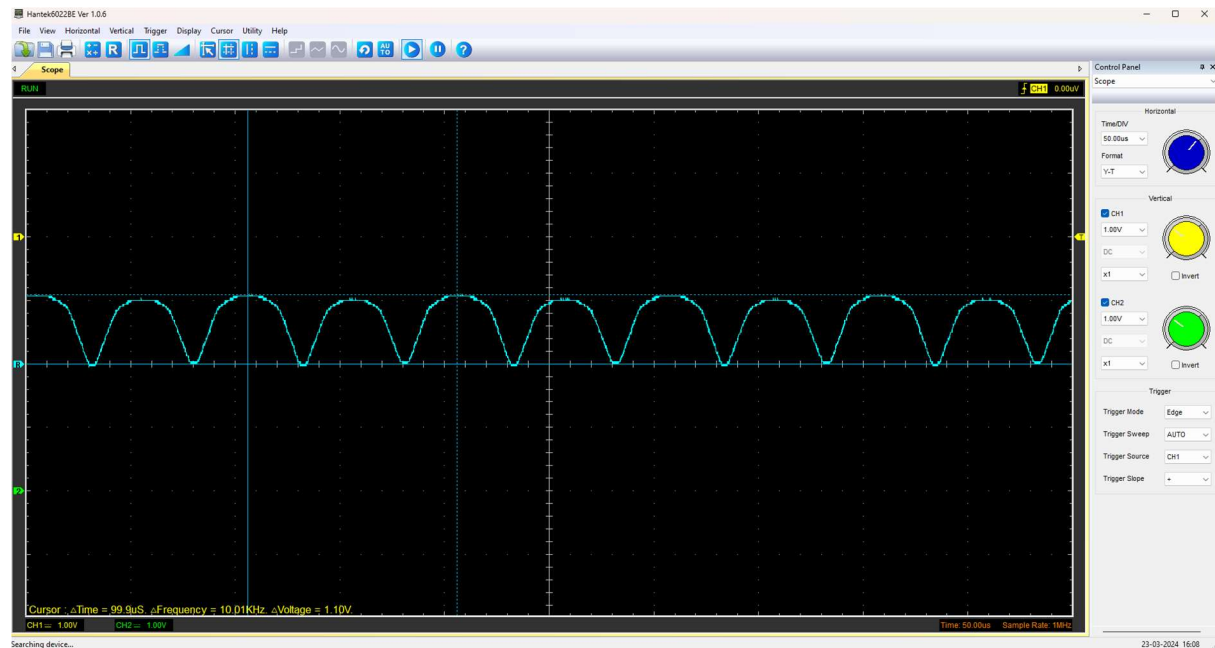
1.1 Scope Time Division Calculation

Time division Calculation = $1/10 \cdot 10 = 1$

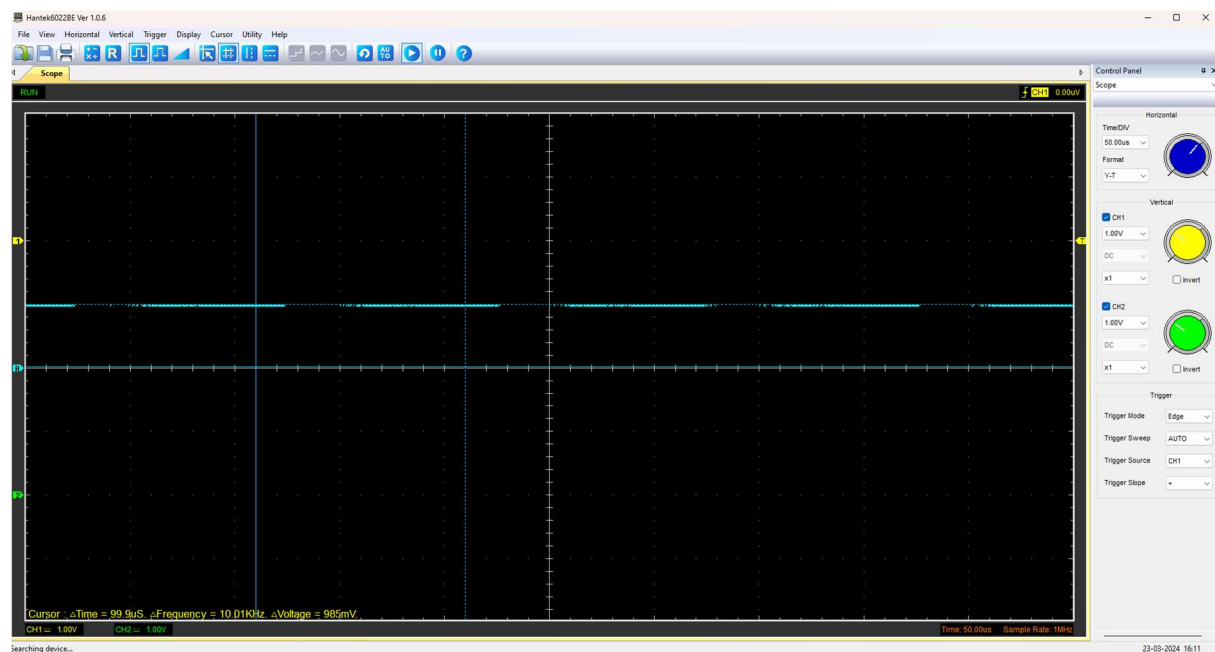
1.2 Function Generator output sine wave



1.3 Unsmoothed Rectifier Wave



1.4 Smoothed Rectifier Wave with Capacitor



1.5 Drop in Voltage Question

When diodes conduct electricity, they have a drop in voltage, during the positive side of the input sinewave the diode conducts and allows the current to flow. This caused the voltage drop and therefore reduces the output voltage, because of this affect the rectified output is slightly lower than the peak input of the sinewave. Another reason for this is that on the negative side of the wave the diode can block flow resulting in there being no output. This caused there to be a lower average voltage output compared to a wave with full rectification. The capacitor can discharge when the voltage is below its peak this also influences lowering the overall voltage. (1)

1.6 Different voltage readings question

	A	B	C	D	E	F	G
1							
2		Peak voltage (v)	Peak to peak Voltage (v)	Root Mean Square	mean		
3	Sine wave	2.23	4.46	1.43	2.04		
4	Unsmoothed Rectifier wave	0.573	1.146	0.522			
5	Smoothed Rectifier with capacitor wave	0	0	0			
6							
7	Different points for sine wave	squared	mean				
8	0.362	0.131044	2.042104				
9	0.824	0.678976					
10	1.24	1.5376					
11	1.7	2.89					
12	2.23	4.9729					
13	Different Point on usmooth rec wave						
14	0.231	0.0534	0.52208				
15	0.462	0.213					
16	0.643	0.414					
17	0.874	0.764					
18	1.08	1.166					
19							
20							

RMS stands for root mean square which represents the effective value of a signal over a set amount of time. This value is calculated by the square root of the mean squared value of different voltage values across a flow cycle. For a continuously changing voltages RMS can be expressed as an integral of the squares of instant values. Alternating Current (AC) and Direct Current (DC) power can be compared using RMS, but you cannot use Voltage reading for RMS calculations as it fluctuates as for the calculations you need constant values. RMS requires a mean value whereas voltages are readings of a set amount not a collection of all readings put together to make one amount. (1) (2)

1.7 Rectifiers use in automotive applications Question

Rectification ensures that vehicles perform optimally and reliably, rectification prevents accidents due to systems having malfunctions. Some of these issues could be starting, charging or the ignition. Rectification makes sure that problems like these don't occur often making the vehicle more reliable and safer for mass usage. Rectification makes sure that lights and indicators don't break or have issues further making the vehicle more reliable and more economically friendly as damages and breaks don't happen as often, so maintenance is cheaper on the car. Rectifying the ECU is very important as it is essentially the brain of the car which signals all the controls the driver inputs whilst driving. This is an essential for production of vehicles as it increases safety and reliability and causes less malfunctions of the vehicle. Rectifying aspects of a vehicle allow it to be road worthy as the vehicle must go through several tests to be eligible to be driven on the road, this makes it much more likely to pass these tests if this process happens. (3)

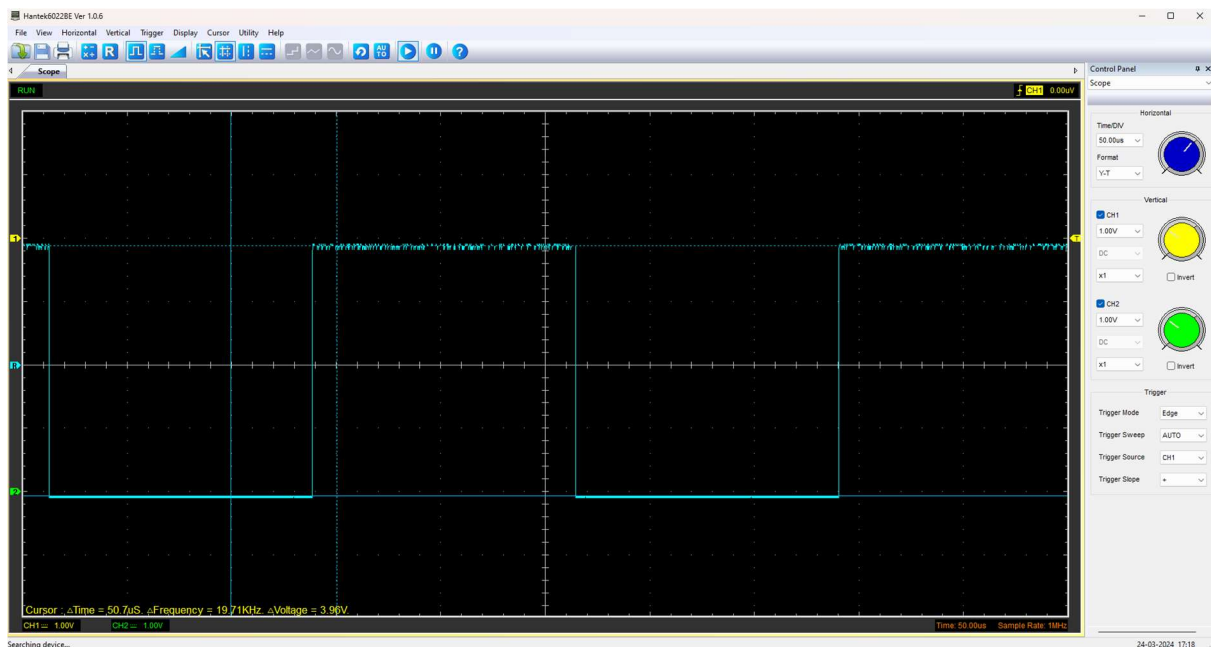
1.8 Probing Question

To allow simultaneous probing you can use two oscilloscope channels, to do this connect one channel to the function generator output and connect the other channel to the rectifier output. Watch both the waveforms on the scope to ensure that the function generator has enough output current to drive the rectifier input. Determine the expected voltage and amplitude using the scope if needed adjust the scope settings such as voltage scale and time to clearly visualise both signals. (4)
(5)

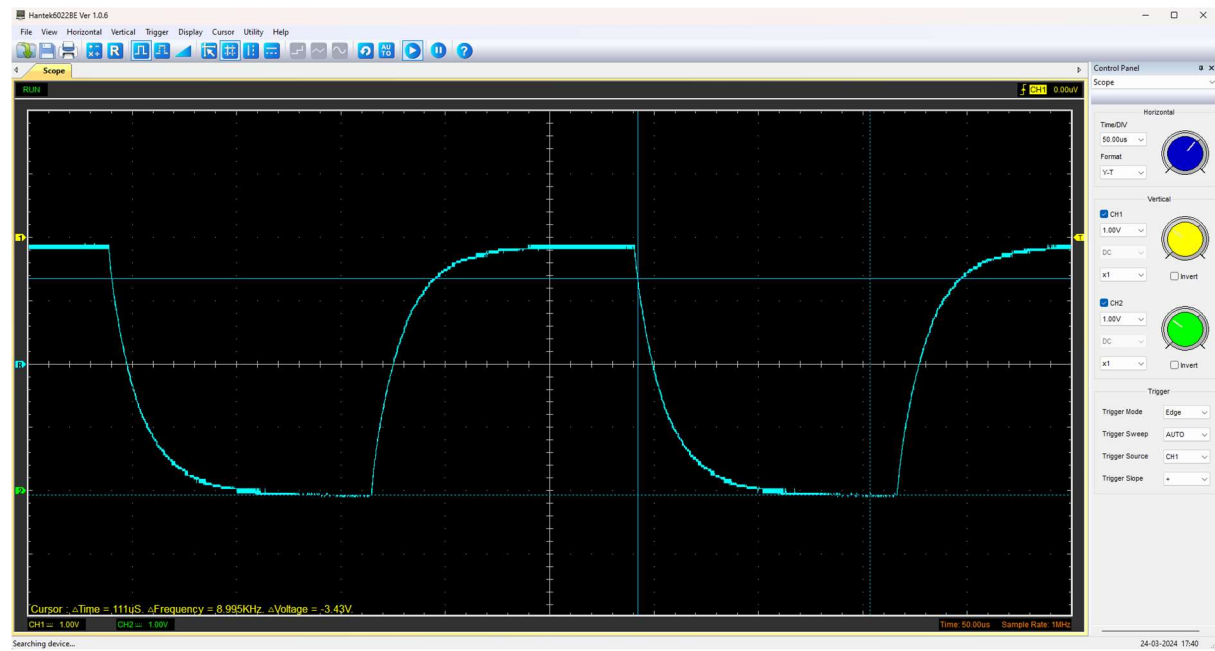
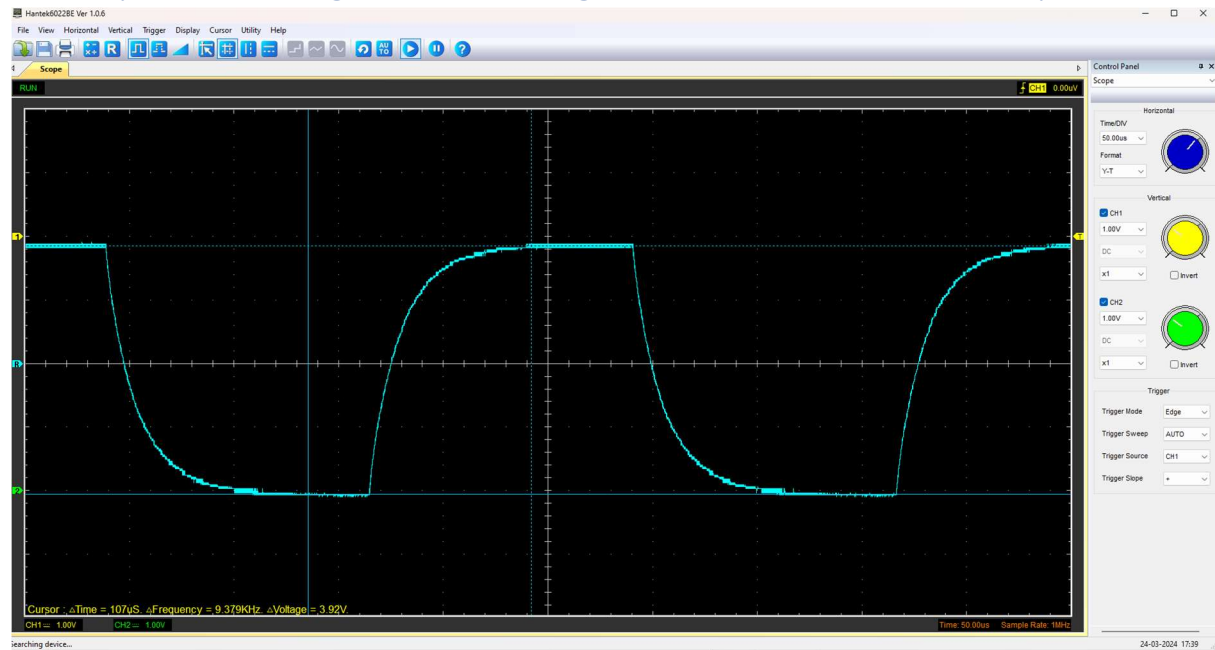
Task 3

2.1 Scope time division calculations

2.2 Function Generator output square wave



2.3 Capacitor Charge and discharge wave marked at correct point.



2.4 Basic Capacitor Calculations

2.5 Capacitor Discharge Table

2.6 Gradient plot and Calculations

2.7 Capacitor uses

- 1) Super capacitors are used for rapid energy storage and release, they can provide bursts of power during acceleration or braking in electrical and hybrid vehicles. They complement batteries by handling the high current demands efficiently. This helps the battery last longer per charge as energy comes from other sources. (6) (7)
- 2) Regenerative braking systems, during the braking phase energy is captured and stored inside of capacitors which can then be used for helping the car accelerate and other functions. (8)
- 3) Efficient mass transit systems, capacitors contribute to these systems as they do not need to use fossil fuels, they help manage energy flow and improve overall system performance. (7)
- 4) Phase shift and power factor correction, capacitors are essential for electric motors, they ensure that the performance of both starting and running phases of the vehicle are as efficient as possible. (9)
- 5) Engine downsizing and emissions reduction, in internal combustion engines and hybrid vehicles supercapacitors assist in these areas by stabilizing the electrical system output and capturing energy from various processes during movement phases of a car. (7)
- 6) Super capacitors are also used for electromagnetic valve control to improve valve timing. (10)
- 7) capacitors are also used for electrical systems such as brake actuators and steering assistance. (10)
- 8) Convenience systems, air conditioning, window wipers, automatic windows and seat adjustments are all assisted by aluminium electrolytic capacitors. (6)
- 9) Safety features such as steering assistance, airbag deployment systems and braking systems. The bursts of energy supplied by capacitors are essential for these features. (6)

- 10) Capacitors are also used for ECU processes such as battery control, petrol and diesel engine controls and electrical motor drives. Eg fuel pumps and fans. (6)

2.8 Inaccuracies Question

Not calibrating the oscilloscope will increase the risk of having inaccuracies as well as not calibrating the active probes that are being used. Having a low bit depth which corresponds to resolution of the sample will increase inaccuracy as you are not able to read very specific point of the data. Having a good dynamic range within your oscilloscope will increase accuracy as the sample will not reach the dynamic limit also allowing for a higher bit rate furthermore increasing the accuracy of your sample data. (11)

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