

University of Wales Trinity Saint David

Wales Institute of Science and Art

Electric Circuits Testing and Applications

ACHA4010 Electrical Control Systems

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1. Task 2 Full Bridge Rectifier

TIME (s)	VOLTAGE
0.1	3.0118
0.2	3.0118
0.3	3.0118
0.4	3.0118
0.5	3.0118
0.6	3.0118
0.7	3.0118
0.8	3.0118
0.9	3.0118
1.0	3.0118
1.1	3.0118
1.2	3.0118
1.3	3.0118
1.4	3.0118
1.5	3.0118
1.6	3.0118
1.7	3.0118
1.8	3.0118
1.9	3.0118

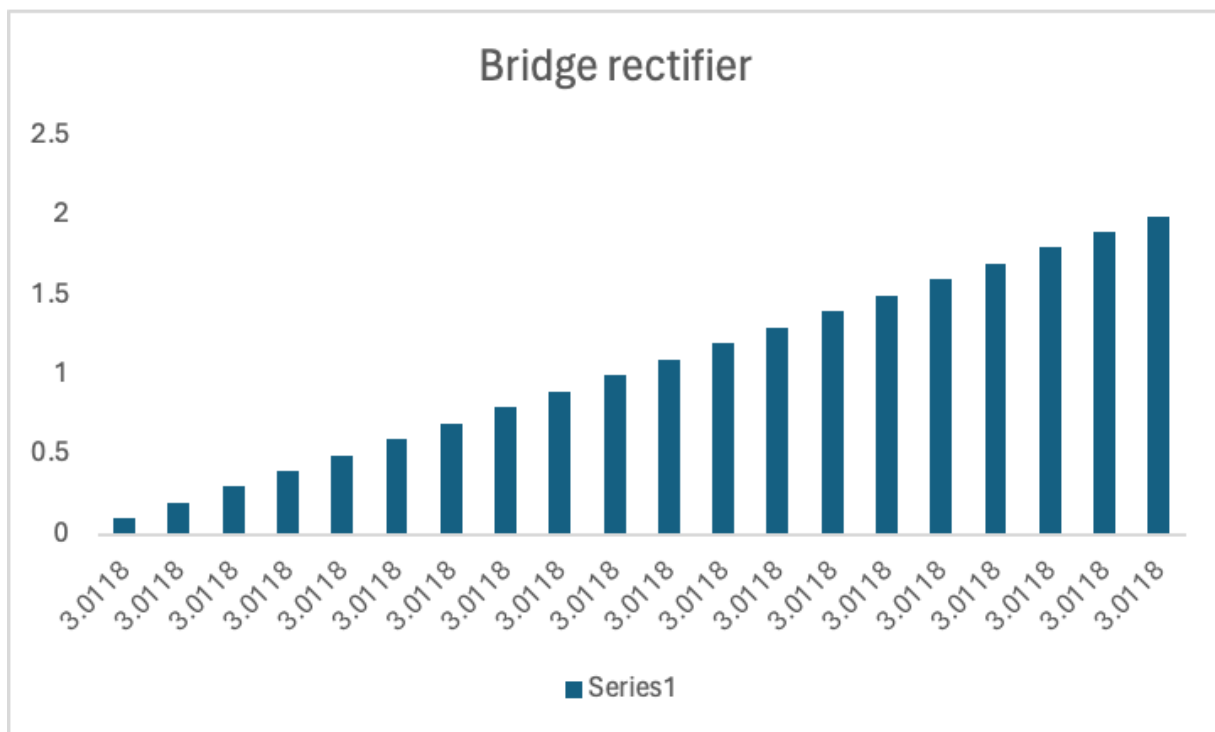
2.0	3.0118
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#CLOCK = 0.050

SIZE = 1047552

#PROBE = 0

#VOLTDIV = 6



a. Time division calculations:

Sine wave time period (T) = $1/f$

Where T = time period & f = frequency

T = $1/10 = 0.1$ seconds (for one full period)

b. Function generator output sine wave

Function generator output = Amplitude x sin (2 π *frequency*time + phase)

Function generator output = 0.00126 V

- c. Unsmoothed rectifier wave**
- d. Smoothed rectifier wave with capacitor**
- e. The rectifier DC output is lower than the peak of sinewave input, explain which factors cause this drop.**

One of the main causes of the dip in the rectifier DC output relative to the sine wave input peak is the voltage drops between the rectifier circuit's resistors and diodes. Diodes lower the output voltage because of their forward voltage drop, which is normally between 0.6 and 0.7 volts. Furthermore, because resistors have inherent resistance, they add to voltage losses in the circuit. The combined effect of these elements is a DC output that is lower than the highest input voltage. The literature on electronics has extensively documented this phenomenon (1).

- f. Show in a table your: peak positive input voltage, peak to peak voltage and root mean square (RMS). Then through research explain what the RMS is and why it is different.**

Peak +ve input voltage	Peak to peak voltage	Root Mean square
3.0118 V	3.0745 V	0.316

An AC signal's effective voltage can be calculated using the Root Mean Square (RMS)

voltage. The square root of the average of the squares of all instantaneous voltage values across a whole cycle is used to compute it. RMS is roughly 0.707 times the peak voltage for sinusoidal waves. Since RMS takes into account the complete waveform as opposed to peak values, which only take into account the extremes, it is essential for power estimates

and DC system comparisons. Unlike peak or peak-to-peak values, which only record maximum or total voltage differences, respectively, RMS offers a standardized measurement of AC voltage that takes into consideration both time and magnitude (2).

g. Research the common use of rectification on different vehicles and explain their importance

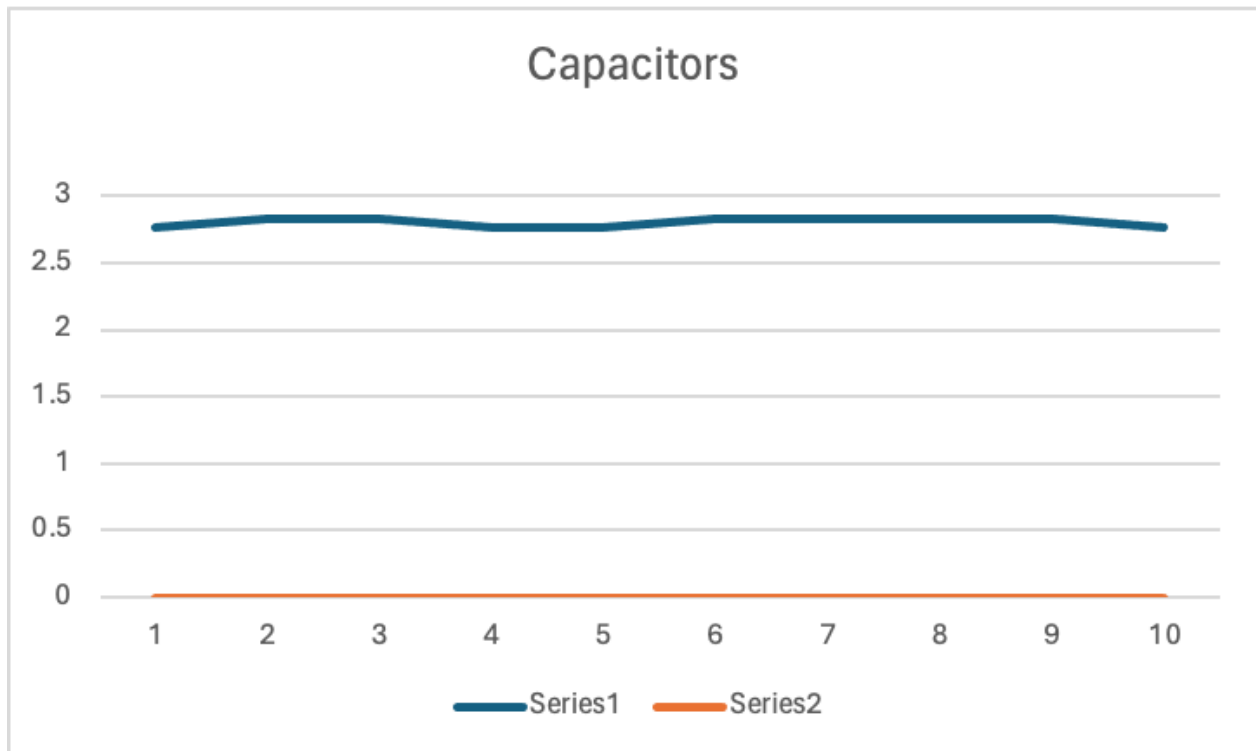
In a variety of vehicles, rectification is essential to the smooth operation of electrical systems. Alternators in cars use rectification to transform the alternating current (AC) produced by the spinning magnetic field into direct current (DC), which is necessary for powering electrical components and charging the battery. The vehicle's battery is kept charged by this DC power, which is also used to power electrical systems like lights and ignition, as well as electronic parts like sensors and control units. Furthermore, rectifiers are essential parts of hybrid and electric cars because they change the AC power coming from the regenerative braking system or the onboard charger into DC to charge the high-voltage traction battery. In order to provide DC power for essential components like as avionics, communication systems, and navigation equipment, rectification is used in alternators and generators in airplanes. In the same way, rectification is essential for maritime vessels because it makes it easier to convert generator AC power into DC power, which powers batteries and other onboard electrical systems like communication, navigation, and lighting. Rectification, in its whole, guarantees a steady and dependable supply of DC power in a variety of vehicle applications, supporting the safe and effective functioning of those vehicles (3).

- h. With the Scopes in class, you are not able to probe the input of the function generator on one channel whilst simultaneously probing the rectifiers out put on another. Explain why this is and through research what you can use to allow simultaneous probing.**

One of the main causes of the incapacity to simultaneously probe the function generator's input and the rectifier's output on different channels in class scopes is the shared grounding setup and channel limitations. There are usually just two or four input channels available on most class scopes. Each signal needs its own channel when probing the rectifier output and the function generator input at the same time. It's also crucial to take the grounding setup into account when employing many channels at once. Because the rectifier and the function generator share a ground, trying to probe them both at the same time with different channels may result in ground loop problems, which could impair measurement accuracy and cause undesired signal distortions.

Researchers frequently use differential probes or isolated channel probes to get over this restriction and enable the simultaneous testing of numerous signals with different channels. Without creating issues with ground loops, these probes are made to measure the voltage differential between two places in the circuit. Researchers may precisely measure signals across components such as rectifiers and function generators at the same time by employing differential probes. This allows for a thorough examination of circuit behavior without sacrificing measurement integrity (4).

2. Task 3 Identify Capacitors



a. Scope time division calculations

10 divisions so 10 milliseconds

b. Function generator output square wave

c. Capacitor charge and discharge wave marked at correct points

d. Basic capacitor calculations

$$T = RC$$

$$T = (10 \text{ ohm})(10 \times 10^{-6} \text{ F})$$

$$T = 10^{-5} \text{ seconds}$$

e. Capacitor discharge table

Time (s)	Voltage (V)	ln (V)	dy = y2 – y1 dy = ln(V)2 – ln(V)1	dx = x2 – x1 dx = Time2 – Time1	dy/dx	Average
0.006499	-0.6902	1.196888	x	x	x	-899.984
0.006665	-1.1294	1.054521	-0.14237	0.000166	-857.631	
0.006831	-1.5059	0.913928	-0.14059	0.000166	-846.947	
0.006997	-1.8196	0.779508	-0.13442	0.000166	-809.757	
0.007163	-2.1333	0.624172	-0.15534	0.000166	-935.76	
0.007329	-2.3843	0.479768	-0.1444	0.000166	-869.903	
0.007495	-2.6353	0.310935	-0.16883	0.000166	-1017.07	
0.007661	-2.8235	0.162544	-0.14839	0.000166	-893.92	
0.007827	-3.0118	-0.01187	-0.17441	0.000166	-1050.69	
0.007993	-3.1373	-0.14769	-0.13582	0.000166	-818.181	

f. Gradient plot and calculations

R = 10 ohms

C(f) = 10 μ

Cap Marking = 106

C = 1/(R x average)

% difference = ((10 μ F - 11.11 μ F)/10 μ F) x 100%

Delta difference = 10 μ F - 11.11 μ F

Capacitance = 111.11 μ F

Percentage difference = 1011.1%

Delta difference = -101.11 μ F

g. Capacitor uses

Listed below are a list of areas that capacitors can be used in:

- **Power Factor Correction:** By counteracting the effects of inductive loads, capacitors are employed in electrical systems to improve power factor, which raises energy efficiency and lowers electricity costs.
- **Energy Storage:** In electrical systems, capacitors act as backup power sources by storing electrical energy and releasing it when necessary to temporarily supply power during voltage variations or outages.
- **Noise filtering:** By lowering interference and enhancing signal quality in audio, video, and data transmission systems, capacitors reduce electrical noise and electromagnetic interference (EMI) in electrical circuits.
- **Motor Start Capacitors:** By temporarily storing electrical energy and transferring it to the starter motor, capacitors are employed in automobile and motorcycle applications to provide the first boost of power necessary to start the engine.
- **Ignition Systems:** An essential part of car ignition systems, capacitors store electrical energy from the battery and release it in the form of high-voltage pulses that ignite the combustion chamber's air-fuel combination.
- **Voltage Regulation:** By reducing voltage swings and supplying a steady source of power to delicate components, capacitors regulate voltage levels in electrical and electronic systems.
- **DC-DC Converters:** DC-DC converter circuits use capacitors to effectively store and transfer energy, changing the DC voltage level to another when needed in a variety of electrical systems found in cars and motorcycles.

- **Filtering and Decoupling:** In power supply circuits, capacitors are used for filtering and decoupling. They eliminate ripple voltage and give electronic components a steady DC voltage, guaranteeing reliable and correct functioning.
- **Lighting Systems:** To provide a steady power supply and stabilize voltage, capacitors are used in lighting systems, such as those in cars and motorcycles, to produce consistent brightness and extended bulb life.
- **Audio Systems:** Capacitors are crucial parts of car and motorcycle audio systems. They act as coupling capacitors, blocking DC voltage while letting AC audio impulses go through, so that music is reproduced clearly and distortion-free.

h. Inaccuracies question

There are a number of reasons why measurements can be inaccurate, including defective equipment, unfavorable weather, and human error. Inaccuracies in electrical measurements can be attributed to signal attenuation along the measurement channel, noise interference, and errors in instrument calibration. Furthermore, temperature and humidity fluctuations may have an impact on the precision of measurements, particularly in delicate electronic components. Studies indicate that incorrect probe connections, insufficient measuring instrument bandwidth, and inappropriate grounding procedures are common causes of errors in electrical measurements. Disparities between the specified and measured values can also result from measurement mistakes caused by transient effects and parasitic capacitance in the circuit. Using calibrated tools, using the right measuring methodologies, and taking the environment into account when testing are all essential to reducing measurement mistakes. Accurate readings can

only be achieved by performing routine maintenance and calibration on test equipment.

Furthermore, to reduce noise interference and enhance measurement reliability, shielding techniques and appropriate grounding procedures should be used (5).

3. References:

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