Universidad Carlos III de Madrid

Department of Electronic Technology

ELECTRONIC COMPONENTS AND CIRCUITS

Part I (Continuous evaluation test 1)

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Time: 1 hour and 30 minutes

EXERCISE 1

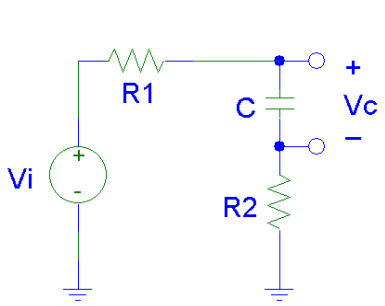


Figure 1a

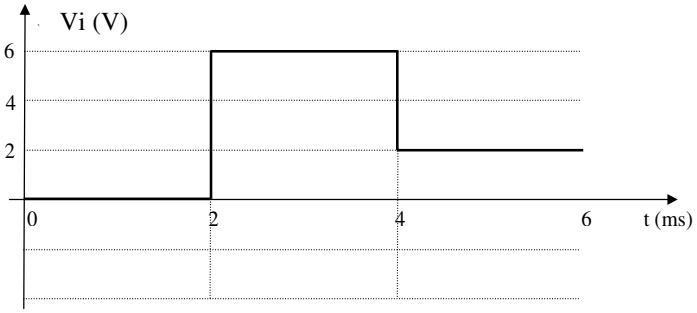


Figure 1b

DATA: R1 = 1 kΩ C = 100 nF R2 = 1 kΩ

The voltage Vi applied to the circuit of Figure 1a is a pulse as outlined in Figure 1b.

a) Plot the voltage Vc, matching the most significant instants of time of Vi and Vc

b) Find the approximate values of Vc for the following instants of time: 2 ms, 2.2 ms, 3 ms, 4ms and 5ms.

EXERCISE 2

In the circuit of Figure 2, Vg is a sinusoidal voltage source whose amplitude is set to 1 V peak. The frequency can be changed. R = 1KΩ, C = 100nF.

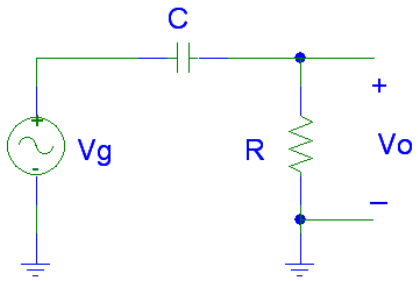


Figure 2

a) Obtain the equation of Vo as a function of Vg, C, R and ω (angular frequency).

b) Calculate the amplitude of Vo in the case ω = 1/(R·C).

c) Calculate the phase shift between Vo and Vg in the case ω = 10/(R·C).

d) Why the RC circuit is a high-pass?

EXERCISE 3

The signals in Figure 3 are observed in an oscilloscope with the following adjustments: 10μs/Div, 200 mV/Div.

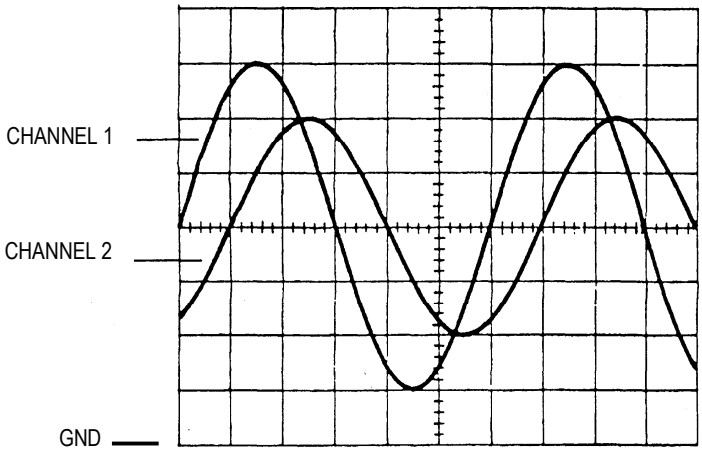


Figure 3

a) Obtain the values of the period, the frequency and the amplitude of both signals.

b) Calculate the phase shift between them (time shift in microseconds, phase shift in radians and degrees).

The signals are obtained in DC mode. The ground reference (GND) is in the bottom of the oscillogram.

c) Calculate the voltage of channel 1 measured by a polimeter in DC mode.

d) Calculate the voltage of channel 1 measured by a polimeter in AC mode.

EXERCISE 4

We want to fabricate a resistor with the following characteristics: nominal value 2.2KΩ and dissipation up to ¼W. A resistive film is used:

Film resistance: 300Ω/□ Maximum dissipation: 1W/cm^2

a) Calculate the adequate length and width.

Information of the datasheet: Resistance 2K2 (room temperature of 25ºC) and temperature coefficient 10^{-4} Ω/(Ω·ºC)

b) Which is the value of the resistor at 125ºC?

c) Answer again the question b with a nominal resistance of 22KΩ?

d) Give the range of values of a resistor with the following parameters:

Nominal value 2.2 KΩ Tolerance 10%

EXERCISE 5

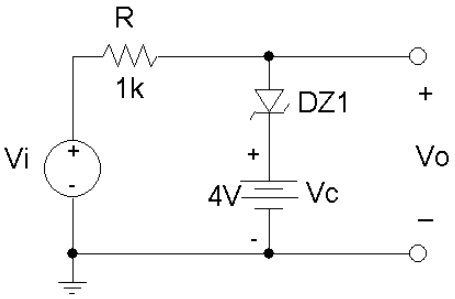


Figure 4a

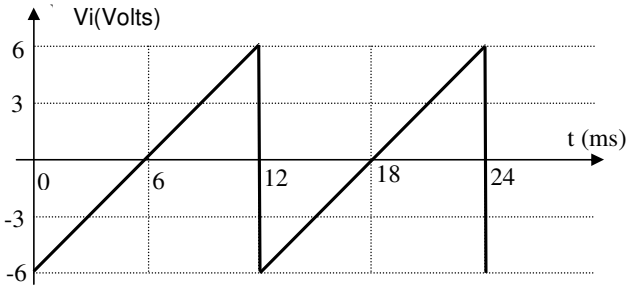


Figure 4b

DATA (zenner diode): ZENNER voltage: Vz = 4.7 V ON voltage: V_D= 0.7 V

The voltage applied to circuit of Figure 4a is a series of ramps depicted in Figure 4b.

a) Plot the transfer function of the circuit of Figure 4a: Vo versus Vi.

b) Plot the output voltage Vo as a function of time. Match the most significant instants of time of Vi and Vo.

EXERCISE 6

The scheme of the Figure 5 is an application circuit with diodes. Vred is the accessible voltage one can found in an electric plug at home.

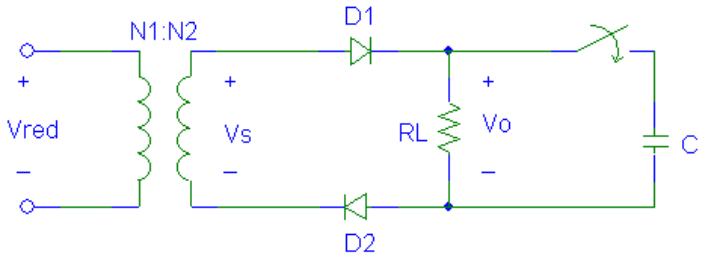


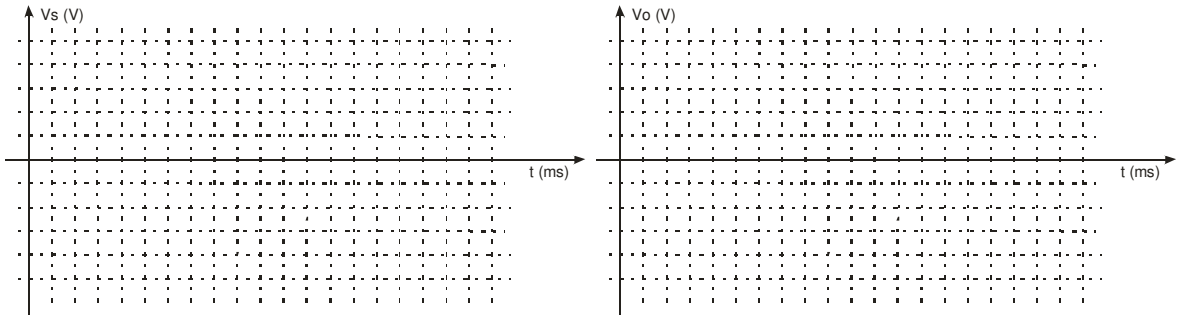
Figure 5

DATA:

Vred = 220 Vrms; 50 Hz
N1/N2=26
Ideal diodes ($V_{D\text{-}ON}$ = 0V)
RL= 300 Ω

a) Which type of application is?

b) If C is disconnected plot the voltages Vs and Vo. Give details of time and amplitude.



c) With the capacitor C connected, obtain the value of C so as the ripple is less than 1Vpp.