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

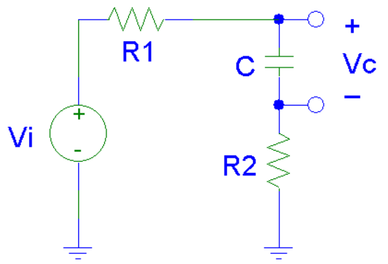


Figure 1a

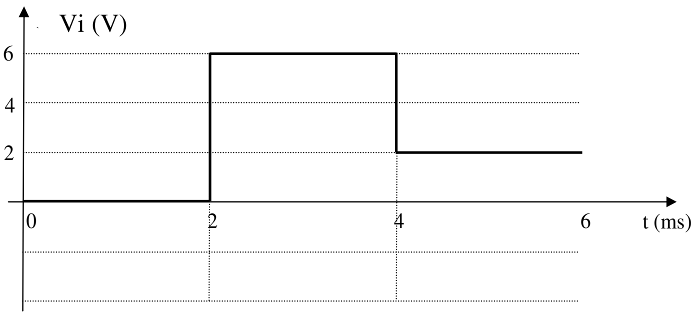
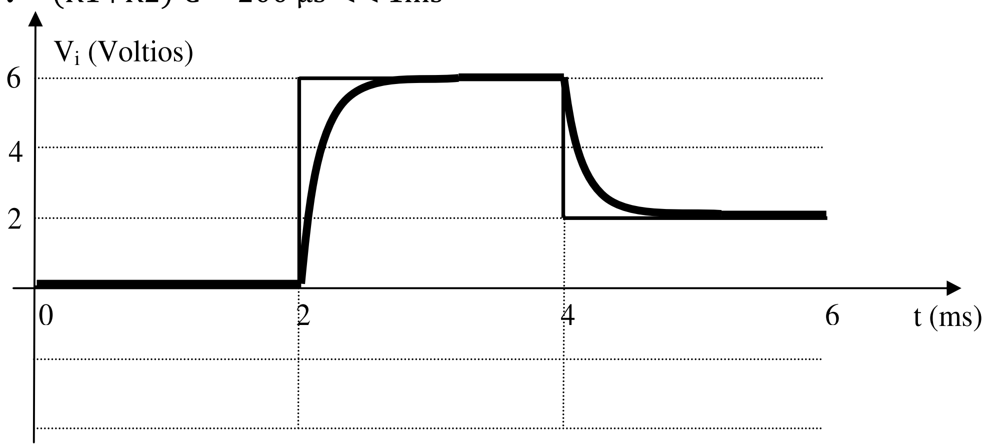


Figure 1b

DATA: R1 = 1 kΩ C = 100 nF R2 = 1 kΩ

a) $\tau = (R1+R2)\cdot C = 200\ \mu s << 1ms$



b) Vc (2ms) = 0V

Vc (2.2ms) = 63% · 6V = 0.63 · 6V (t = 1τ)

Vc (3ms) = 6V (t = 5τ)

Vc (4ms) = 6V

Vc (5ms) = 2V (t = 5τ)

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.

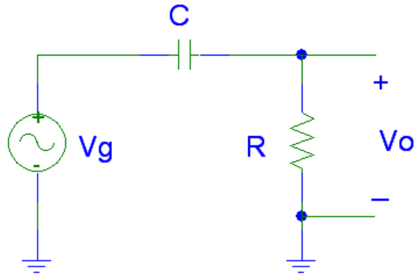


Figure 2

a) Vo

$$Vo = Vg\frac{j\omega CR}{1 + j\omega CR}$$

b) ω = 1/(R·C)

$$|Vo| = |Vg|\left|\frac{j}{1+j}\right| = \frac{|Vg|}{\sqrt{2}}$$

|Vo| = 1/√2 V peak

c) ω = 10/(R·C).

$$\phi_{Vo} - \phi_{Vg} = -arctg(-1/10) = 5.7^{o}$$

d) f→0 ⇨ Vo = 0 V
f→∞ ⇨ Vo ≈ Vg

EXERCISE 3

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

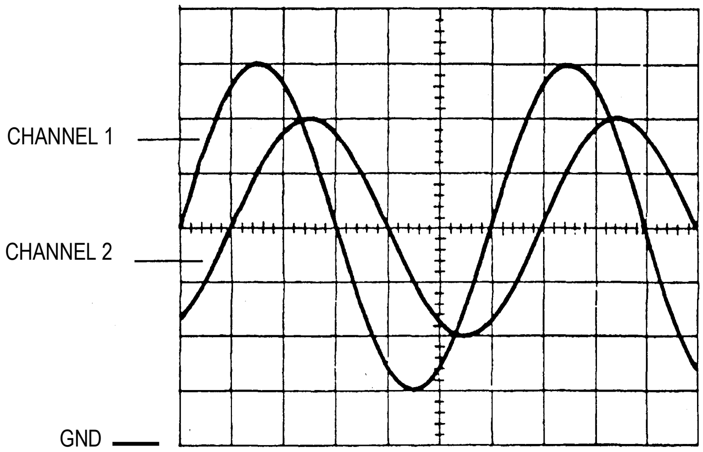


Figure 3

a) $T = 60\ \mu s$ $\quad f = 1/60\ MHz$ $\quad V1 = 600\ mV\ pk$ $\quad V2 = 400\ mV\ pk$

b) $t = 10\ \mu s$ $\quad \phi = 60$ º $\quad \phi = \pi/3\ rad$

c) $V1\ (DC) = 800\ mV$

d) $V1\ (AC) = 600 / \sqrt{2}\ mV\ (rms)$

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) $L / W = 7.33$ □ $\quad W = 1.85\ mm$ $\quad L = 13.54\ mm$

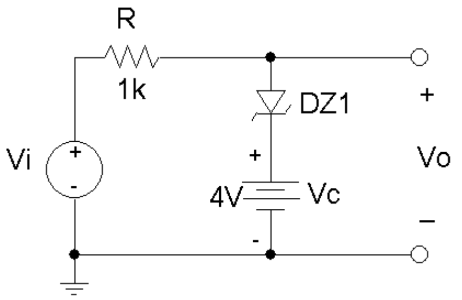
Information of the datasheet: Resistance 2K2 (room temperature of 25ºC) and temperature coefficient 10^{-4} Ω/(Ω·ºC)

b) R (125º) = 2.2K · (1+0.01) = 2.222 KΩ

c) R' (125º) = 22K · (1+0.01) = 22.22 KΩ

d) $R = 2.2K\ (1 \pm 0.1)$ $\quad$ Min 1.98 K Ω $\quad$ Max 2.42 K Ω

EXERCISE 5



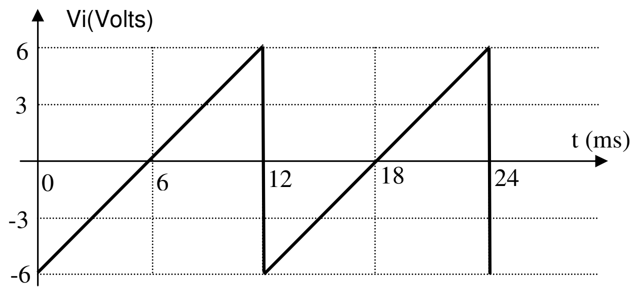
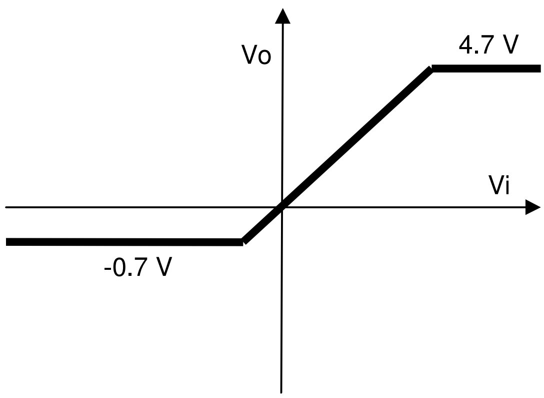


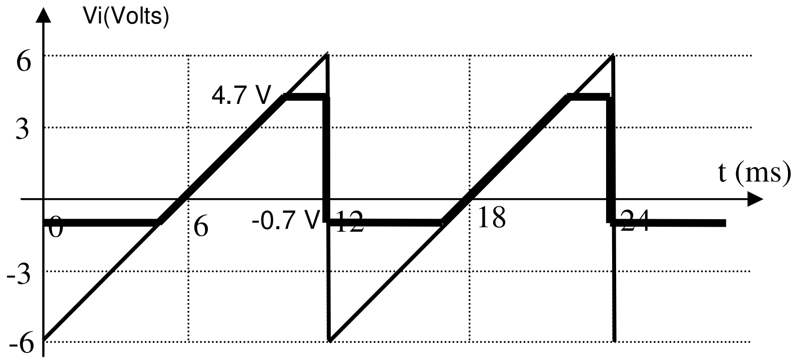
Figure 4a **Figure 4b**

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

a) Transfer function



b) Output voltage 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.

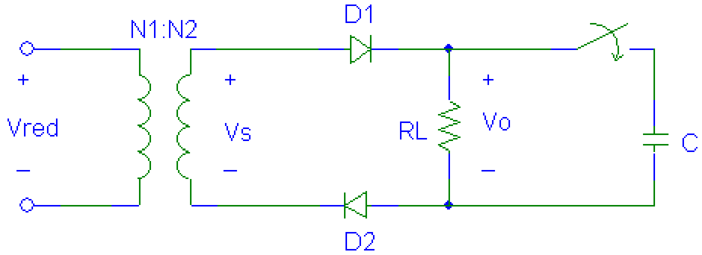


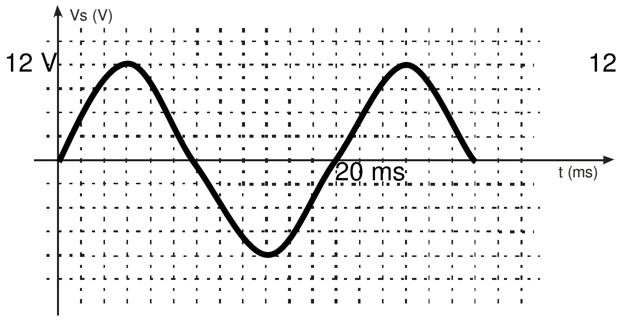
Figure 5

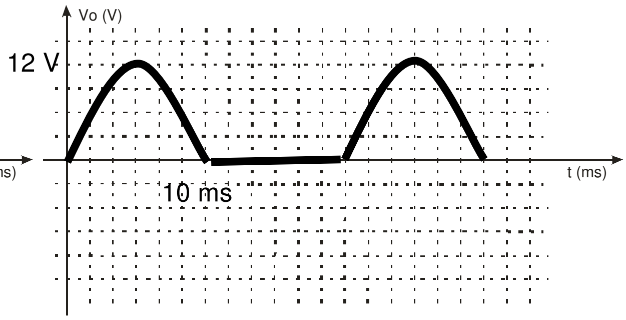
DATA:

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

a) AC to DC conversion: Half-wave rectifier

b) Vs and Vo





c) Value of C so as the ripple is less than 1Vpp.

C = (T/RL)·(Vp/Vr) = 800 μF