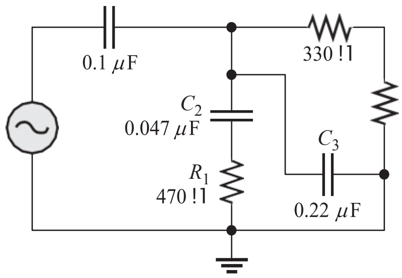
PARTE 3: CIRCUITOS EN SERIE-PARALELO

SECCIÓN 15–7 Análisis de circuitos RC en serie-paralelo

50. ¿Es el circuito de la figura 15-100 predominantemente resistivo o predominantemente capacitivo?

► FIGURA 15-100



$$\boldsymbol{R1} = \mathbf{330}\Omega + \mathbf{180}\Omega = \mathbf{510}\Omega$$

$$Xc1 = \frac{1}{2\pi(15000\text{Hz})(0.1) * 10 - 6} = -j106.103\Omega$$

$$Xc2 = \frac{1}{2\pi(15000\text{Hz})(0.047) * 10 - 6} = -j225.751\Omega$$

$$Xc3 = \frac{1}{2\pi(15000\text{Hz})(0.22) * 10 - 6} = -j48.228\Omega$$

$$z1 = \frac{1}{\frac{1}{510} - \frac{1}{48.228j}} = 4.5202 - j47.80$$

$$z2 = 470 - j225.751$$

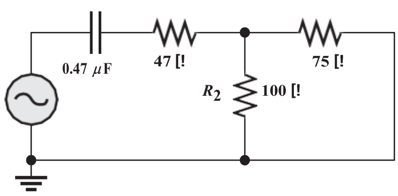
$$z3 = \frac{1}{\frac{1}{4.5202 - j47.80} + \frac{1}{470 - j225.751}} = 7.7078 - 45.051j$$

$$Zeq = 7.7078 - 45.051j - 106.103j = 7.70 - 151.15j$$

Por lo tanto es un circuito RC.

52. Para el circuito de la figura 15-101, determine lo siguiente:

(a) (b) (c) (d) (e) (f)



$$Ra = \frac{1}{\frac{1}{75\Omega} + \frac{1}{100\Omega}} = 42.8471\Omega$$

$$Xc1 = \frac{1}{2\pi(1000\text{Hz})(0.47) * 10 - 6} = -j338.627\Omega$$

$z1 = 47 - j338.627 = 341.8731 < -82.098$

$\text{Zeq} = 42.841\Omega + 47 - j338.627 = 89.8471 - 338.27j = 350.3421 < -75.1411$

$$\text{IT} = \frac{Vs}{Zeq} = \frac{15}{350.3421 < -75.1411} = 0.042815 < 75.1411(A)$$

$Vz1 = \text{I} * \text{Z2} = 0.042815 < 75.1411 * 341.8731 < -82.098 = 14.63 < -6.95(v)$

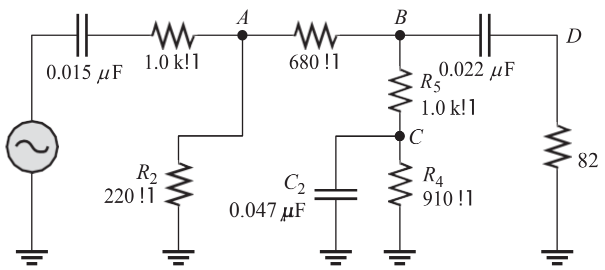
$Vra = \text{I} * \text{Ra} = 0.042815 < 75.1411 * 42.8471\Omega = 1.8344 < 75.1411(v)$

$Vc1 = \text{I} * \text{C1} = 0.042815 < 75.1411 * 338.627 < -90 = 14.498 < -14.85(v)$

$Vr1 = \text{I} * \text{C1} = 0.042815 < 75.1411 * 47 = 2.01 < 75.14$

54. Determine el voltaje y su ángulo de fase en cada punto rotulado en la figura 15-103.

RA 15-103



$$Xc1 = \frac{1}{2\pi(2500\text{Hz})(0.015) * 10 - 6} = -j4244.1318\Omega = -j4.244k\Omega$$

$$Xc2 = \frac{1}{2\pi(2500\text{Hz})(0.047) * 10 - 6} = -j1354.5101\Omega = -j1.3545k\Omega$$

$$Xc3 = \frac{1}{2\pi(2500\text{Hz})(0.022) * 10 - 6} = -j2893.7262\Omega = -j2.8937k\Omega$$

$z4 = 1.0 - 4.244j$

$$z2 = \frac{1}{\frac{1}{0.91} + \frac{1}{-j1.3545}} = 0.626 - 0.4212j$$

$z1 = 0.82 - 2.893j$

$z3 = z2 + 1.0k\Omega = 0.626 - 0.4212j + 1.0 = 1.626 - 0.4212j$

$$z5 = \frac{1}{\frac{1}{1.626 - 0.4212j} + \frac{1}{0.82 - 2.893j}} = 1.0028 - 0.7055j$$

$$z6 = z5 + 0.68k\Omega = 1.6828 - 0.7055j$$

$$z7 = \frac{1}{\frac{1}{1.6828 - 0.7055j} + \frac{1}{0.22k\Omega}} = 0.1976 - 8.2911j * 10 - 3$$

$$zeq = z7 + z4 = 0.1976 - 8.2911j * 10 - 3 + 1.0 - 4.244j = 1.1976 - 4.2522j = 8.775 < -75.497$$

$$IT = IA = \frac{10 < 0}{8.775 < -75.497} = 1.1394 < 75.4978\ (ma)$$

$$Vz7 = VA = IA * Z7 = 1.1394 < 75.4978 * 0.1977 < -2.4026 = 0.2253 < 73.095\ (v)$$

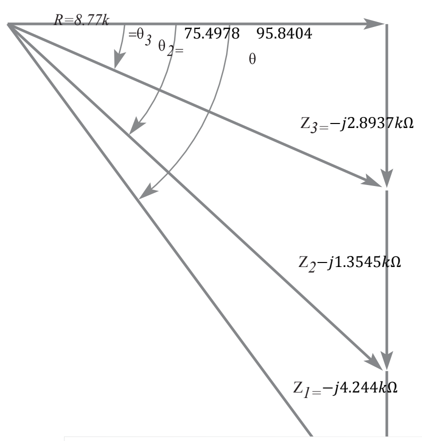
$$Iz6 = \frac{vz7}{z6} = \frac{0.2253 < 73.095}{1.8247 < -22.745} = 0.1234 < 95.8404\ (ma)$$

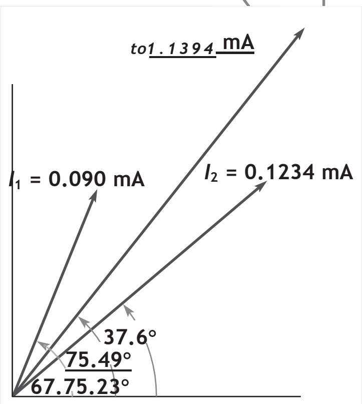
$$Vz5 = vB = VD = Iz6 * Z5 = 0.1234 < 95.8404 * 1.2261 < -35.127 = 0.1513 < 60.71\ (v)$$

$$Iz3 = \frac{Vz5}{z3} = \frac{0.1513 < 60.71}{1.6796 < -14.522} = 0.090 < 75.2327 (ma)$$

$$Vz2 = Vc = Iz3 * Z2 = 0.090 < 75.2327 * 0.7545 < -33.934 = 0.0679 < 41.2983\ (v)$$

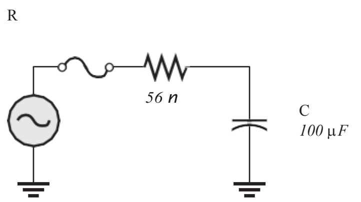
56. Trace el diagrama fasorial de voltaje y corriente para la figura 15-103.





SECCIÓN 15–8 Potencia en circuitos RC

58. En la figura 15-88, ¿cuáles son la potencia real y la potencia reactiva?



$$xc1 = \frac{-j}{\mathbf{2\pi(20Hz)(100) * 10 - 6}} = -j79.577\Omega$$

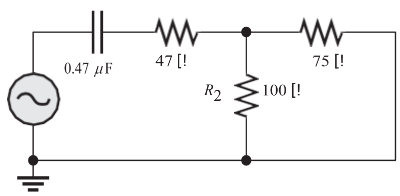
$$z1 = 56 - 79.577j = 137.392 < -35.394$$

$$IT = \frac{V}{Z1} = \frac{10 < 0}{137.392 < -35.394} = 0.0727 < 35.394$$

$$Preal = It^2 * R = (0.0727 < 35.394)\text{^}2 * 56 = 0.2959 < 70.788\,W$$

$$Qc = It^2 * xc = (0.0727 < 35.394)^2 * 79.577 < -90 = 0.4205 < -19.212w$$

60. Determine Preal, Pr, Pa, y FP para el circuito de la figura 15-101. Trace el triángulo de potencia.



$$\mathrm{IT} = \frac{Vs}{Zeq} = \frac{15}{350.3421 < -75.1411} = 0.042815 < 75.1411(A)$$

$$Pr = It^2 * R = (0.042815 < 75.1411)^2 * 89.8471 = 0.1647 < 150.28(\ W)$$

$$Qc = It^2 * xc = (0.042815 < 75.1411)^2 * (-338.27) = 0.620 < -29.7178(W)$$

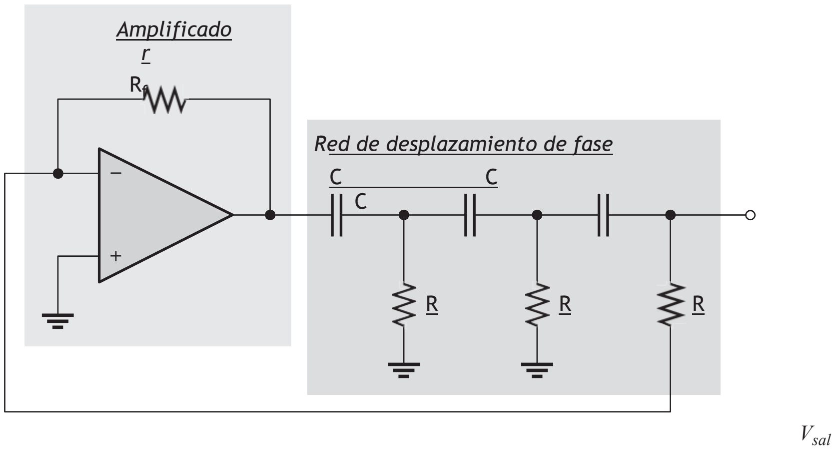
$$Qc = IT * Vt = (0.042815 < 75.1411) * 15v = 0.6422 < 75.1411$$

Fp=cos(75.1411)=0.2564

SECCIÓN 15–9 Aplicaciones básicas

62. Calcule la frecuencia de oscilación para el circuito de la figura 15-62 si todos los capacitores son de

0.0022 mF y todos los resistores de 10 kÆ.

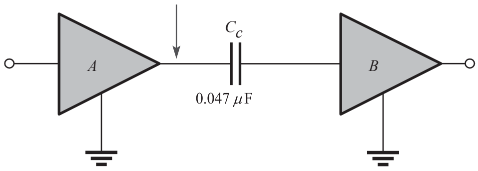


$$fr = \frac{1}{2\pi\sqrt{16} * RC} = \frac{1}{2\pi\sqrt{16} * 10k\Omega * 0.0022uf} = 1.80khz$$

64. El valor rms del voltaje de señal que sale del amplificador A en la figura 15-105 es de 50 mV. Si la resistencia

de entrada al amplificador B es de 10 kÆ, ¿qué tanto de la señal se pierde debido al capacitor

de acoplamiento cuando la frecuencia es de 3 kHz?

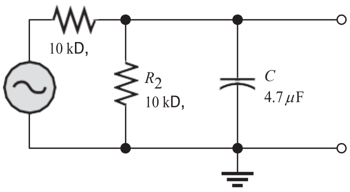


$$fr = \frac{1}{2\boldsymbol{\pi}\sqrt{16} * RC} = \frac{x}{2\boldsymbol{\pi}\sqrt{16} * 10k\Omega * 0.0022uf} = 3khz$$

SECCIÓN 15–10 Localización de fallas

*66. Los capacitores de la figura 15-107 han desarrollado un resistencia de fuga de 2 kÆ. Determine los voltajes

de salida en esta condición para cada circuito.



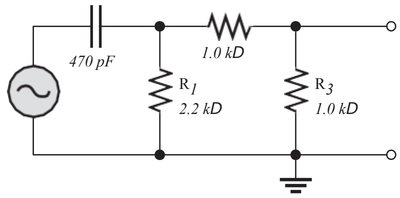
$$xc1 = \frac{-j}{2\boldsymbol{\pi}(\mathbf{10Hz})(\mathbf{4.7}) * \mathbf{10-6}} = -j3.38627k\Omega$$

$$z1 = \frac{1}{\frac{1}{-j3.38627k\Omega} + \frac{1}{10k\Omega}} = 1.0287 - 3.0379j = 3.20736 < -71.2925$$

$$Zeq = z1 + 10k = 3.20736 < -71.2925 + 10 = 11.4394 < -15.400$$

$$IT = \frac{V}{Z} = \frac{1 < 0}{11.4394 < -15.400} = 0.08741 < 15.400\ (ma)$$

$$Vsl = I * Z1 = 0.08741 < 15.400\ (ma) * 3.20736 < -71.2925 = 0.2803 < -55.8925(v)$$



$$xc1 = \frac{-j}{2\boldsymbol{\pi}(\mathbf{100Hz})(\mathbf{470}) * \mathbf{10 - 10}} = -j33.8627k\Omega$$

$$Ra = 2.0k\Omega + 2.0k\Omega = 4.0k\Omega$$

$$Rb = \frac{1}{\frac{1}{4.0k\Omega} + \frac{1}{2k\Omega}} = 1.33k\Omega$$

$$z1 = 1.33k\Omega - j33.8627 = 33.88 < -87.750$$

$$IT = \frac{V}{Z1} = \frac{5 < 0}{33.88 < -87.750} = 0.1475 < 87.75(ma)$$

$$Vrb = It * rb = 0.1475 < 87.75(ma) * 1.33k\Omega = 0.1962 < 87.750(v$$

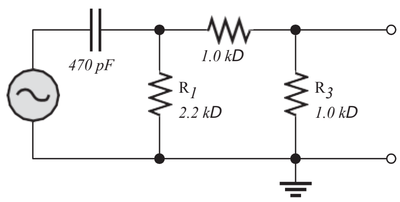
$$Ira = \frac{Vrb}{ra} = \frac{0.1962 < 87.750}{4} = 0.0490 < 87.750(ma)$$

$$Vr1 = Vsl = Ira * r1 = 0.0490 < 87.750 * 2.0k\Omega = 0.098114 < 87.750(v)$$

68. Determine el voltaje de salida para el circuito de la figura 15-107(b) para cada uno de los siguientes

modos de falla, y compárelo con la salida correcta:

(a) C abierto (b) C en cortocircuito (c) abierto (d) abierto (e) abierto



A) Nos da ov en la salida ya que no se energiza la fase.

B)

$$Ra = 1 + 1 = 2\text{k}\Omega$$

$$Rb = Req = \frac{1}{\frac{1}{2}+\frac{1}{2.2}} = 1.0476\text{k}\Omega$$

$$It = \frac{Vt}{Rt} = \frac{5}{1.0476} = 4.7728(ma)$$

$$I = \frac{V}{R} = \frac{5}{2} = 2.5(ma)$$

$$Vsalida = I * 1 = 2.5(v)$$

C)

$$xc1 = \frac{-j}{2\boldsymbol{\pi}(\mathbf{100Hz})(\mathbf{470}) * \mathbf{10-10}} = -j33.8627k\Omega$$

$$Zeq = 2 - 33.8627j$$

$$It = \frac{Vt}{Rt} = \frac{5 < 0}{33.9217 < -86.6199} = 0.1473 < 86.61(ma)$$

$$Vsalida = I * 1 = 0.1473 < 86.61 * 1 = 0.1473(v)$$

D)

Nos da ov en la salida ya que no se energiza la fase.

E)

$$xc1 = \frac{-j}{2\boldsymbol{\pi}(\mathbf{100Hz})(\mathbf{470}) * \mathbf{10-10}} = -j33.8627k\Omega$$

$$Zeq = 3.2 - 33.8627j$$

$$It = \frac{Vt}{zt} = \frac{5 < 0}{3.2 - 33.8627j} = 0.1470 < 84.601(ma)$$

$$Vsl = 5(v)$$