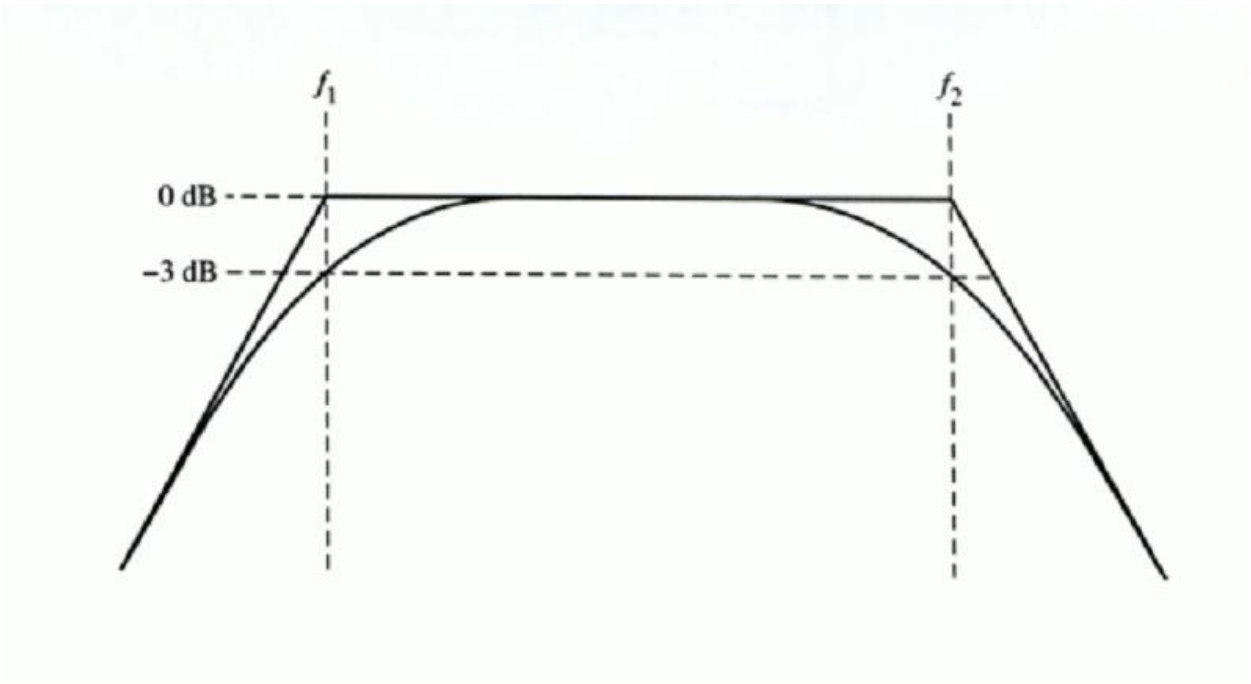
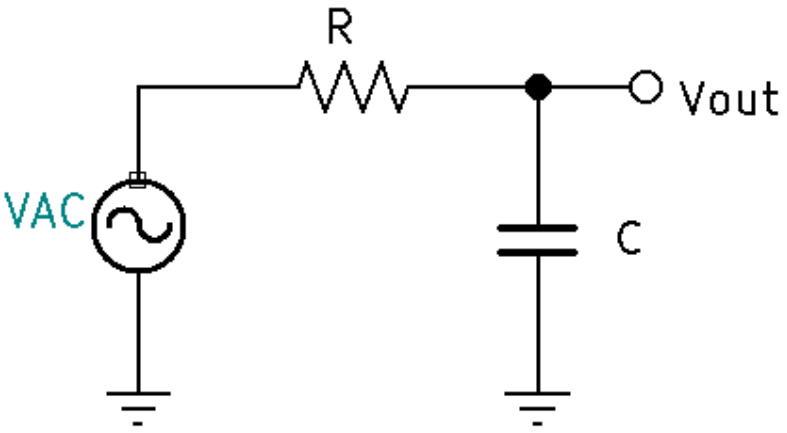
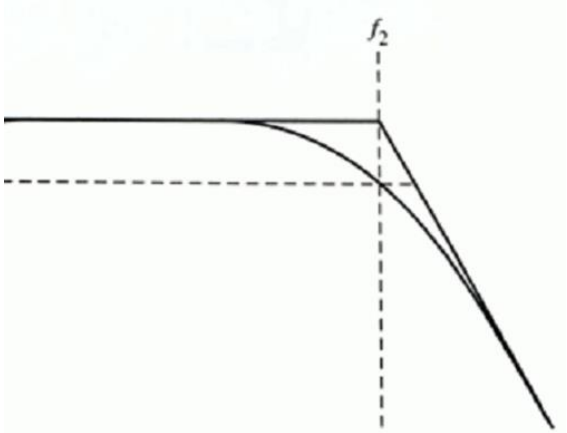
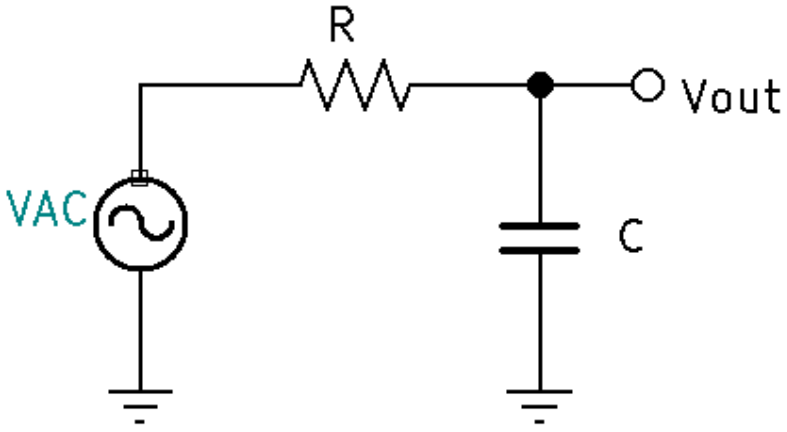
Bode Plot:

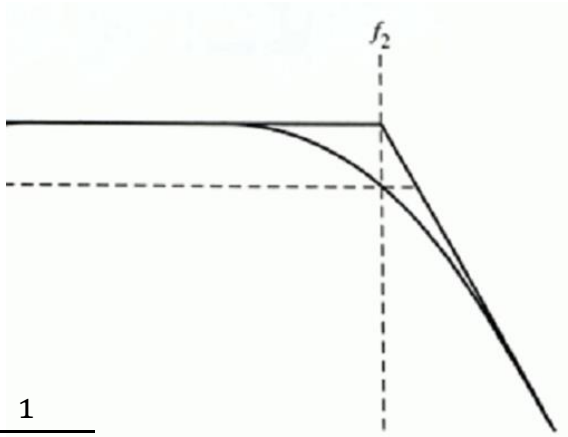






- $FcH = f_2$
- $@f_2,\ X_c = R$
- $X_C = \frac{1}{2\pi fC}$
  - $R = \frac{1}{2\pi f_2 C}$
  - $f_2 = \frac{1}{2\pi RC}$





- $\Delta v_{dB} = 20log\frac{Vout}{Vin}$
- $\Delta v_{dB} = 20log\frac{1}{\sqrt{1+(\frac{f}{f_2})^2}}$
  - $20log\frac{Vout}{Vin} = 20log\frac{1}{\sqrt{1+(\frac{f}{f_2})^2}}$
    - $\frac{Vout}{Vin} = \frac{1}{\sqrt{1+(\frac{f}{f_2})^2}}$
      - $Vout = Vin \times \frac{1}{\sqrt{1+(\frac{f}{f_2})^2}}$

- $Vout = Vin \times \frac{1}{\sqrt{1+(\frac{f}{f_2})^2}}$

- $If\ Vin = 100\%,\ Vout\ becomes\ a\ \%Vin$

  - $Vout\ \%\ of\ Vin = 100\% \times \frac{1}{\sqrt{1+(\frac{f}{f_2})^2}}$

- $Now\ get\ f\ in\ terms\ of\ f_2\ and\ substitute$:

  - $f = 0.25f_2$

  - $Vout\ \%\ of\ Vin = 100\% \times \frac{1}{\sqrt{1+(\frac{0.25f_2}{f_2})^2}}$

  - $Vout\ \%\ of\ Vin = 100\% \times \frac{1}{\sqrt{1+0.0625}}$

  - $Vout\ \%\ of\ Vin = 100\% \times \frac{1}{1.03078}$

  - $Vout\ \%\ of\ Vin = 100\% \times .970$

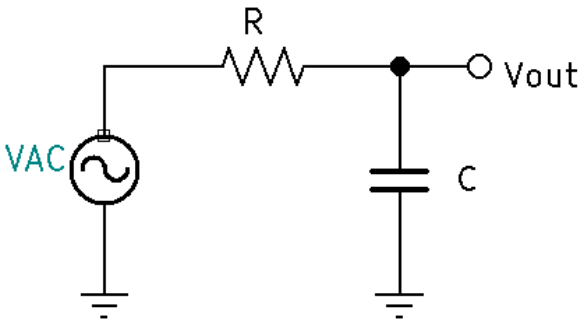
  - $Vout_{0.25f_2} = 97\%\ of\ Vin$

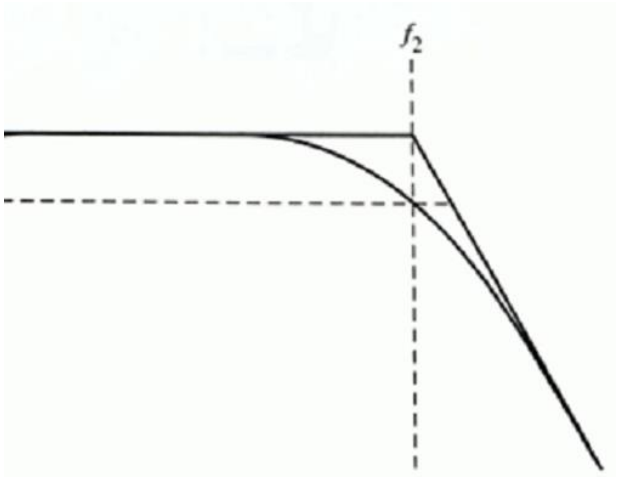
- *Now get f in terms of f_2 and substitute*:
  - $f = 0.5f_2$
    - $Vout\ \%\ of\ Vin = 100\% \times \frac{1}{\sqrt{1+(\frac{0.5f_2}{f_2})^2}}$
    - $Vout\ \%\ of\ Vin = 100\% \times \frac{1}{\sqrt{1+0.25}}$
    - $Vout\ \%\ of\ Vin = 100\% \times \frac{1}{1.118}$
    - $Vout\ \%\ of\ Vin = 100\% \times .894$
    - $Vout_{0.5f_2} = 89.4\%\ of\ Vin$
- *Now get f in terms of f_2 and substitute*:
  - $f = f_2$
    - $Vout\ \%\ of\ Vin = 100\% \times \frac{1}{\sqrt{1+(\frac{f_2}{f_2})^2}}$
    - $Vout\ \%\ of\ Vin = 100\% \times \frac{1}{\sqrt{1+1}}$
    - $Vout\ \%\ of\ Vin = 100\% \times \frac{1}{1.414}$
    - $Vout\ \%\ of\ Vin = 100\% \times .707$
    - $Vout_{f_2} = 70.712\%\ of\ Vin$

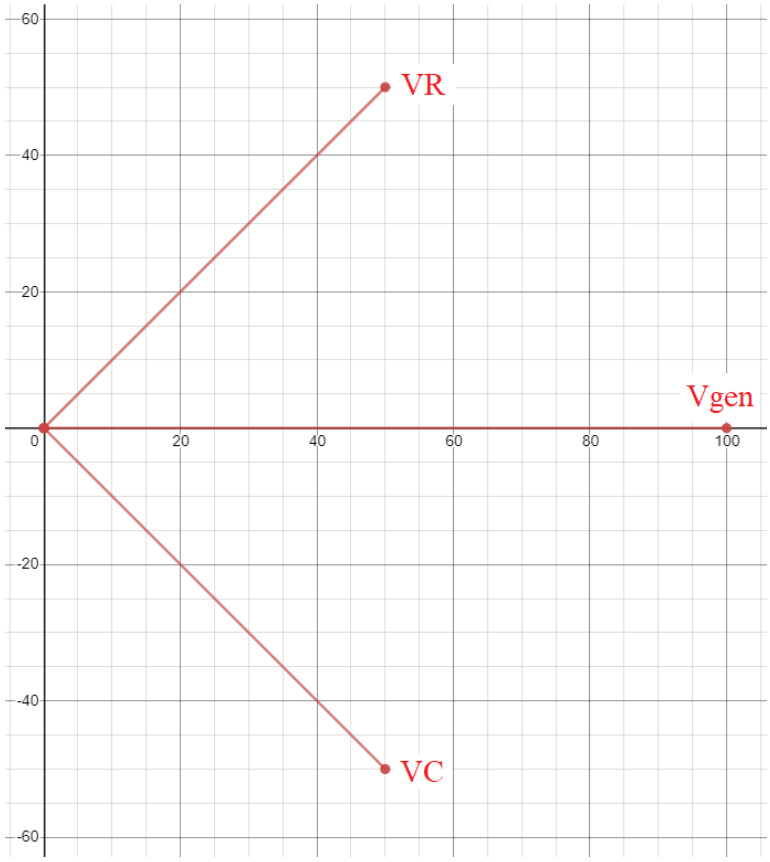
- *Now get f in terms of f_2 and substitute*:
  - $f = 2f_2$
    - $Vout\ \%\ of\ Vin = 100\% \times \frac{1}{\sqrt{1+(\frac{2f_2}{f_2})^2}}$
    - $Vout\ \%\ of\ Vin = 100\% \times \frac{1}{\sqrt{1+4}}$
    - $Vout\ \%\ of\ Vin = 100\% \times \frac{1}{2.236}$
    - $Vout\ \%\ of\ Vin = 100\% \times .447$
    - $Vout_{2f_2} = 44.721\%\ of\ Vin$

- *Now get f in terms of f_2 and substitute*:
  - $f = 10f_2$
    - $Vout\ \%\ of\ Vin = 100\% \times \frac{1}{\sqrt{1+(\frac{10f_2}{f_2})^2}}$
    - $Vout\ \%\ of\ Vin = 100\% \times \frac{1}{\sqrt{1+100}}$
    - $Vout\ \%\ of\ Vin = 100\% \times \frac{1}{10.05}$
    - $Vout\ \%\ of\ Vin = 100\% \times .0995$
    - $Vout_{10f_2} = 9.95\%\ of\ Vin$

- $\Delta v_{dB} = 20log\frac{Vout}{Vin}\ OR\ \Delta v_{dB} = 20log\frac{1}{\sqrt{1+(\frac{f}{f_2})^2}}$
    - $Vout_{0.25f_2} = 97\%\ of\ Vin$
        - $\Delta v_{dB@0.25f_2} = 20log0.97\ OR\ \Delta v_{dB} = 20log\frac{1}{\sqrt{1+(\frac{0.25f_2}{f_2})^2}}$
        - $\Delta v_{dB@0.25f_2} = -0.264dB$
    - $Vout_{0.5f_2} = 89.4\%\ of\ Vin$
        - $\Delta v_{dB@0.5f_2} = 20log0.894\ \ OR\ \Delta v_{dB} = 20log\frac{1}{\sqrt{1+(\frac{0.5f_2}{f_2})^2}}$
        - $\Delta v_{dB@0.5f_2} = -0.973dB$
    - $Vout_{f_2} = 70.712\%\ of\ Vin$
        - $\Delta v_{dB@f_2} = 20log0.70713\ \ OR\ \Delta v_{dB} = 20log\frac{1}{\sqrt{1+(\frac{f_2}{f_2})^2}}$
        - $\Delta v_{dB@f_2} = -3.01dB$
    - $Vout_{2f_2} = 44.72\%\ of\ Vin$
        - $\Delta v_{dB@2f_2} = 20log0.4472\ OR\ \Delta v_{dB} = 20log\frac{1}{\sqrt{1+(\frac{2f_2}{f_2})^2}}$
        - $\Delta v_{dB@2f_2} = -6.99dB$
    - $Vout_{10f_2} = 9.95\%\ of\ Vin$
        - $\Delta v_{dB@10f_2} = 20log0.0995\ OR\ \Delta v_{dB} = 20log\frac{1}{\sqrt{1+(\frac{10f_2}{f_2})^2}}$
        - $\Delta v_{dB@10f_2} = -20.044dB$





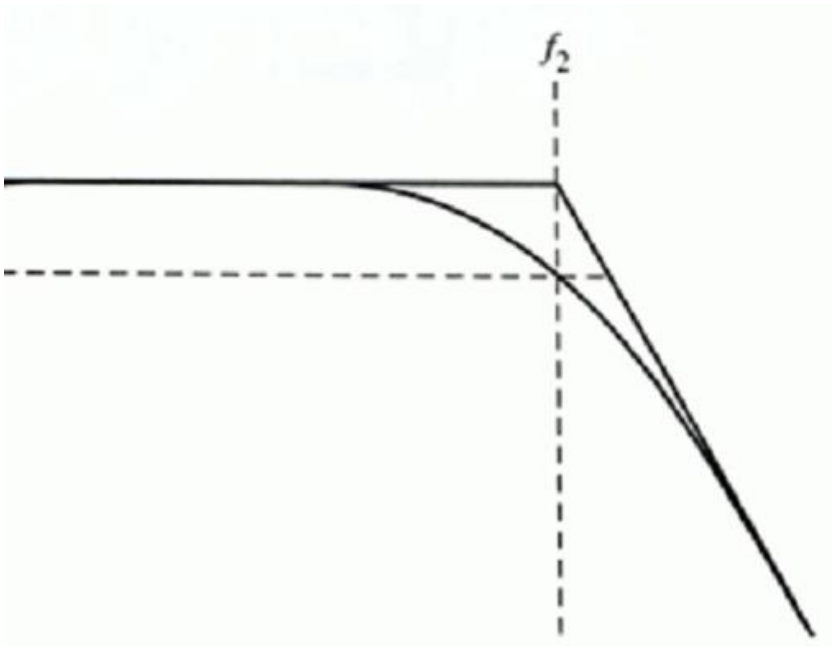


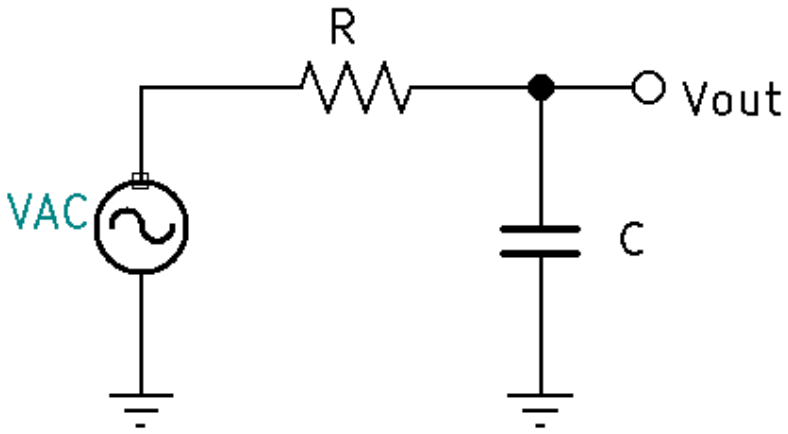
Phase:

- $Vgen = \sqrt{VR^2 + VC^2}$
- $\theta = Cos^{-1}\frac{Vc}{Vgen}$
  - $\frac{Vc}{Vgen} = \frac{Vout\%}{100} = \frac{1}{\sqrt{1+(\frac{f}{f_2})^2}}$
  - $\theta = Cos^{-1}\frac{Vout\%}{100}$
  - $\theta = Cos^{-1}\frac{1}{\sqrt{1+(\frac{f}{f_2})^2}}$

- $\theta = Cos^{-1}\frac{Vout\%}{100}\ or\ \theta = Cos^{-1}\frac{1}{\sqrt{1+(\frac{f}{f_2})^2}}$

- $Vout_{0.25f_2} = 97\%\ of\ Vin$
    - $\theta_{0.25f_2} = Cos^{-1}.97\ OR\ Cos^{-1}\frac{1}{\sqrt{1+(\frac{0.25f_2}{f_2})^2}}$
    - $\theta_{0.25f_2} = -14°$
- $Vout_{0.5f_2} = 89.4\%\ of\ Vin$
    - $\theta_{0.5f_2} = Cos^{-1}.\ 894\ \ OR\ \ Cos^{-1}\frac{1}{\sqrt{1+(\frac{0.5f_2}{f_2})^2}}$
    - $\theta_{0.5f_2} = -26.62°$
- $Vout_{f_2} = 70.71\%\ of\ Vin$
    - $\theta_{f_2} = Cos^{-1}.\ 7071\ \ OR\ \ Cos^{-1}\frac{1}{\sqrt{1+(\frac{f_2}{f_2})^2}}$
    - $\theta_{f_2} = -45°$
- $Vout2_{f_2} = 44.72\%\ of\ Vin\ \ \ OR\ \ Cos^{-1}\frac{1}{\sqrt{1+(\frac{2f_2}{f_2})^2}}$
    - $\theta 2_{f_2} = Cos^{-1}.\ 4472$
    - $\theta 2_{f_2} = -63.44°$
- $Vout10_{f_2} = 9.95\%\ of\ Vin$
    - $\theta 10_{f_2} = Cos^{-1}.\ 0995\ \ \ OR\ \ Cos^{-1}\frac{1}{\sqrt{1+(\frac{10f_2}{f_2})^2}}$
    - $\theta 10_{f_2} = -84.29°$





FCh=F2	Vout=%of Vin	dB	Phase
0.25F2	97%	-0.264dB	−13.664°
0.5F2	89.40%	-0.973dB	-26.62°
1F2	70.71%	-3.01dB	-45°
2F2	44.72%	-6.99dB	−63.44°
10F2	9.95%	-20.044dB	−84.29°