

⊙ Vorbereitung:

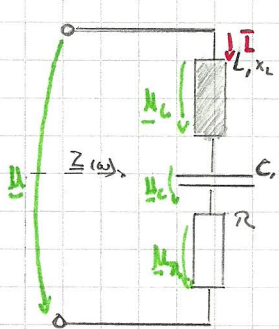
$R = 10 \Omega$

$L = 10 \text{ mH}$

$C = 20 \mu\text{F}$

ges. \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow die f_0 , Q_n/p ; f_{g0} , f_{gU} , f_{res} , Z_{res} , Q_L

a) Reihenschwingkreis



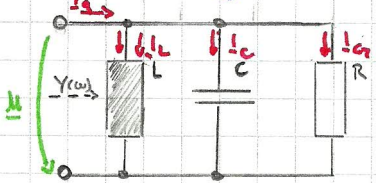
$f_0 = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{10\text{mH} \cdot 20\mu\text{F}}} = 355 \text{ Hz}$ (Resonanzfrequenz)

$Q_n = \frac{1}{R} \cdot \sqrt{\frac{L}{C}} = \frac{1}{10\Omega} \cdot \sqrt{\frac{10\text{mH}}{20\mu\text{F}}} = \sqrt{5} = 2,2$ (Güte des Reihenschwingkreises)

$f_{g0} = f_0 \left(\sqrt{1 + \left(\frac{1}{2Q_n}\right)^2} + \frac{1}{2Q_n} \right) = 355 \text{ Hz} \left(\sqrt{1 + \frac{1}{4 \cdot 5}} + \frac{1}{2\sqrt{5}} \right) = 443 \text{ Hz}$

$f_{gU} = f_0 \left(\sqrt{1 + \left(\frac{1}{2Q_n}\right)^2} - \frac{1}{2Q_n} \right) = 284 \text{ Hz}$

b) Parallelschwingkreis



$f_0 = \frac{1}{2\pi\sqrt{LC}} = 355 \text{ Hz}$

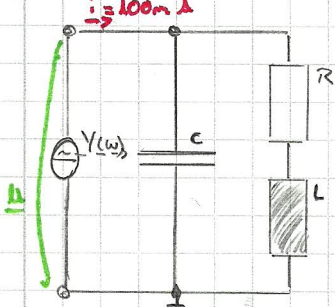
$Q_p = \frac{1}{G} \cdot \sqrt{\frac{C}{L}} = \frac{1}{10\text{S}} \cdot \sqrt{\frac{20\mu\text{F}}{10\text{mH}}} = \frac{\sqrt{5}}{5}$

$f_{g0} = 443 \text{ Hz} = f_0 \left(\sqrt{1 + \left(\frac{1}{2Q_p}\right)^2} + \frac{1}{2Q_p} \right) = 355 \text{ Hz} \cdot \left(\sqrt{1 + \left(\frac{1}{2 \cdot \frac{\sqrt{5}}{5}}\right)^2} + \frac{1}{2 \cdot \frac{\sqrt{5}}{5}} \right)$

$f_{gU} = 284 \text{ Hz} = 355 \text{ Hz} \left(\sqrt{1 + 1,25} + \frac{5}{2\sqrt{5}} \right) = 329 \text{ Hz}$

$f_{gU} = f_0 \left(\sqrt{1 + \left(\frac{1}{2Q_p}\right)^2} - \frac{1}{2Q_p} \right) = 355 \left(\sqrt{2,25} - \frac{5}{2\sqrt{5}} \right) = 185 \text{ Hz}$

c) technischer Parallelschwingkreis



$Y(\omega) = j\omega C + \frac{1}{R + j\omega L} = \frac{R}{R^2 + \omega^2 L^2} + j \left(\omega C - \frac{\omega L}{R^2 + \omega^2 L^2} \right)$

$\omega_{res} = \frac{1}{\sqrt{LC}} \cdot \sqrt{1 - R^2 \frac{C}{L}} = \frac{1}{\sqrt{10\text{mH} \cdot 20\mu\text{F}}} \cdot \sqrt{1 - 10\Omega \frac{20\mu\text{F}}{10\text{mH}}} = 2000 \frac{\text{rad}}{\text{s}}$

$Y_{res} = \frac{R}{R^2 + \omega_{res}^2 \cdot L^2} \rightarrow Z_{res} = R + \frac{\omega_{res}^2 \cdot L^2}{R} = 10\Omega + \frac{(2000 \frac{\text{rad}}{\text{s}})^2 \cdot (10\text{mH})^2}{10\Omega} = 50\Omega$

$f_{res} = \frac{1}{2\pi\sqrt{LC}} \cdot \sqrt{1 - R^2 \frac{C}{L}} = \frac{1}{2\pi} \cdot \omega_{res} = \frac{1}{2\pi} \cdot 2000 \frac{\text{rad}}{\text{s}} = 318 \text{ Hz}$

$Q = \frac{\omega_{res} \cdot L}{R} = \frac{2000 \frac{\text{rad}}{\text{s}} \cdot 10\text{mH}}{10\Omega} = 2$

1a) Auswertung:

* Da Spannungen & Ströme zwischen Plot 2 und 3 nicht verändert wurden, ist nur eine logarithmische Darstellung (oder Frequenz) geschaltet worden. Derfallens wurden die y-Achsenkomponenten in Plot 3 skaliert. Im Plot 3 erhält man eine genauere Ansicht der Maxima, während in Plot 2 die Konvergenz über den Gesamtverlauf besser zu beobachten ist.

$$\Rightarrow B_f = \frac{f_0}{Q} \rightarrow Q_r = \frac{f_0}{B_f} = \frac{356 \text{ Hz}}{158 \text{ Hz}} = \underline{\underline{2,2}} \quad \checkmark$$

$$\Rightarrow Q_n \cdot U = U_{co} \rightarrow Q_v = \frac{U_{co}}{U} = \frac{2,2 \text{ V}}{1 \text{ V}} = \underline{\underline{2,2}} \quad \checkmark$$

\uparrow
 $U_{co} \approx 2,25 \text{ V} \approx 2,2 \text{ V}$

* Plot 3 $Q = \frac{f_0}{B_f} = \frac{356 \text{ Hz}}{160 \text{ Hz}} = \underline{\underline{2,22}} \quad \checkmark$

$$B_f \approx 160 \text{ Hz}$$

$$U_{co} \approx 2,25 \text{ V}$$

$$U_{zo} \approx 1,1 \text{ V}$$

$$Q = \frac{U_{co}}{U} = \frac{2,25 \text{ V}}{1 \text{ V}} = \underline{\underline{2,25}} \quad \checkmark$$

1b) Plot 4

$$f_0^2 = f_{g0} \cdot f_{g2} \rightarrow f_0 = \sqrt{f_{g0} \cdot f_{g2}} \quad ; \quad B_f = f_{g0} - f_{g2}$$

$$\Rightarrow Q = \frac{f_0}{B_f} = \frac{\sqrt{f_{g0} \cdot f_{g2}}}{f_{g0} - f_{g2}} \Rightarrow Q_1 = \frac{f_{01}}{B_{f1}} = \frac{\sqrt{364 \cdot \frac{342}{85}} \text{ Hz}}{(364 - \frac{342}{85}) \text{ Hz}} = \frac{4,09}{\dots} = \underline{\underline{20,30}} \quad \checkmark$$

$$Q_2 = \frac{f_{02}}{B_{f2}} = \frac{\sqrt{444 \cdot \frac{285}{225}} \text{ Hz}}{444 - \frac{285}{225}} \text{ Hz} = \frac{4,04}{\dots} \quad \checkmark \quad ; \quad Q_3 = \frac{f_{03}}{B_{f3}} = \frac{\sqrt{1665 \cdot 75}}{1665 - 75} = \underline{\underline{0,22}} \quad \checkmark$$

2) Plot 5 $U_{co} \approx 1 \text{ V}$

$$Q_p = \frac{f_0}{B_f} = \frac{356 \text{ Hz}}{(331 - 136) \text{ Hz}} = \underline{\underline{0,44}}$$

3) Part 6

f_{res} liegt bei $\varphi = 0 \Rightarrow f_{res} = 318 \text{ Hz}$

f_{max} bei $U_{0max} = f_{max} = 354 \text{ Hz}$

~~$$Z_{res} = \frac{R^2 + 2\pi \cdot f_{res} \cdot L^2}{R} = \frac{(10\Omega)^2 + 2\pi \cdot 318 \text{ Hz} \cdot (10 \text{ mH})^2}{10\Omega} = \underline{\underline{10,018 \Omega}}$$~~

~~$$Z_{max} = \frac{R^2 + 2\pi \cdot f_{max} \cdot L^2}{R} = \frac{(10\Omega)^2 + 2\pi \cdot 354 \text{ Hz} \cdot (10 \text{ mH})^2}{10\Omega} = \underline{\underline{10,022 \Omega}}$$~~

$$Z_{res} = \frac{U_0}{I} = \frac{5,0 \text{ V}}{100 \text{ mA}} = \underline{\underline{50 \Omega}} \quad \checkmark$$

$$Z_{max} = \frac{U_{max}}{I} = \frac{5,5 \text{ V}}{100 \text{ mA}} = \underline{\underline{55 \Omega}} \quad \checkmark$$



1a) Plot 2

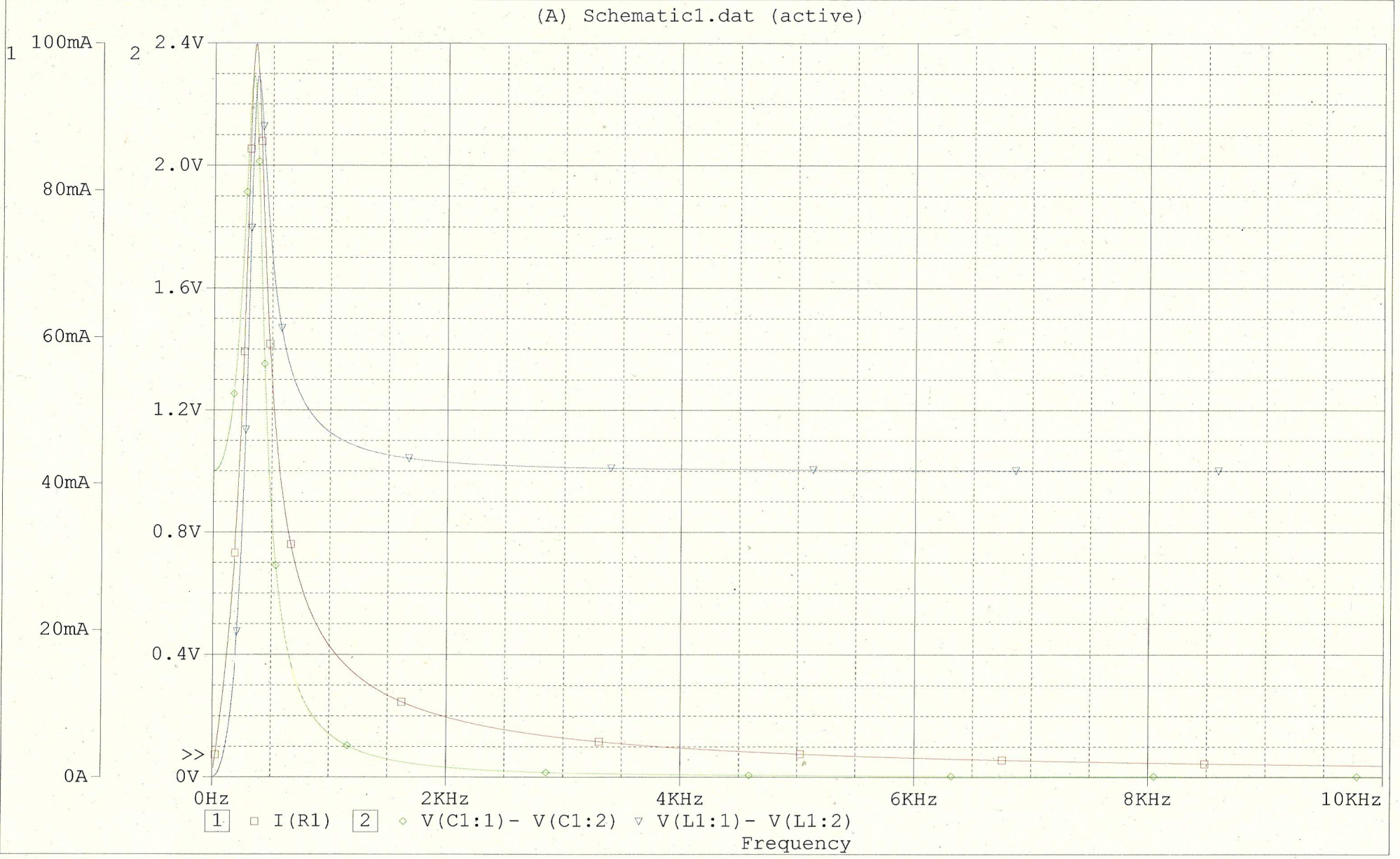
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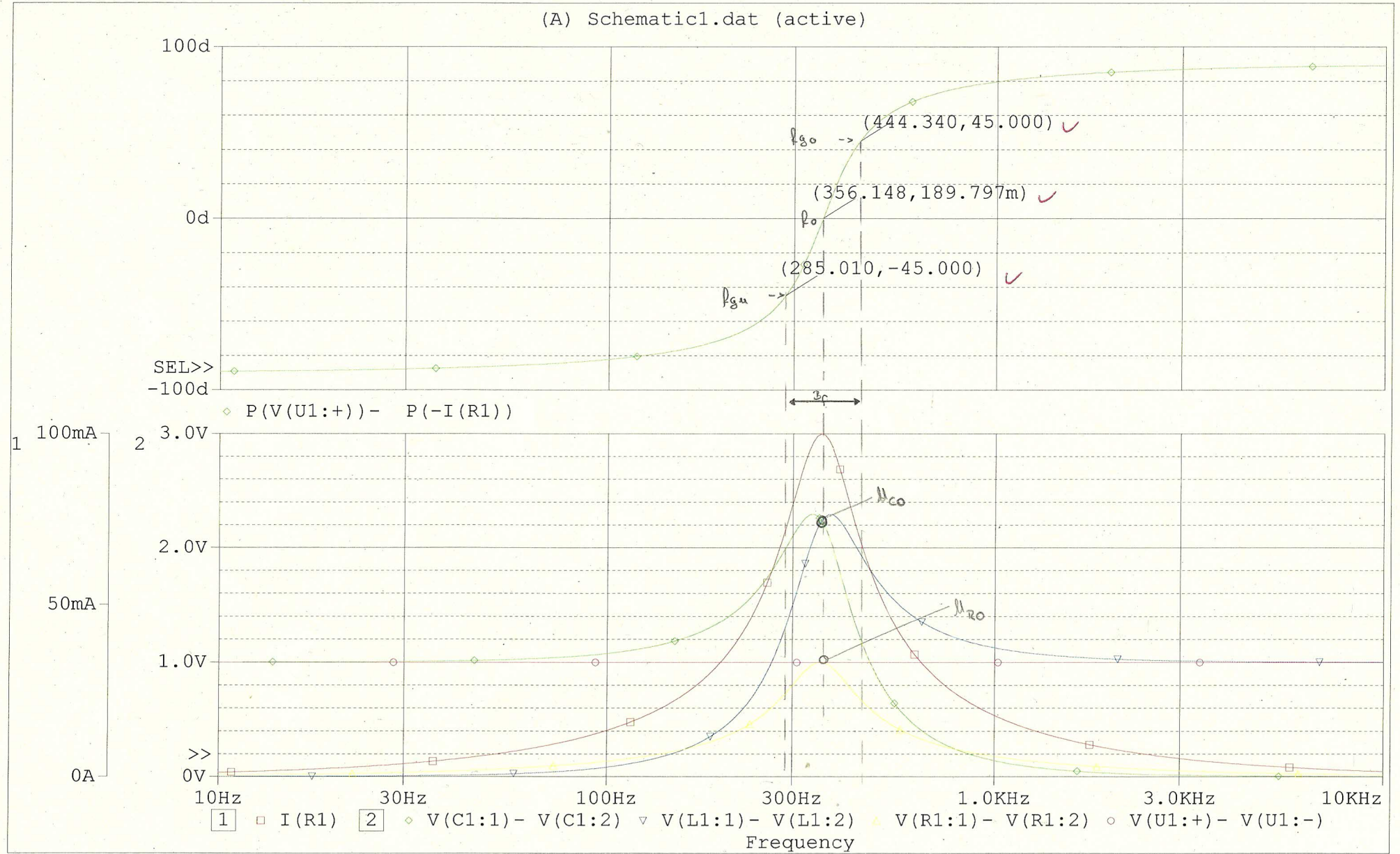
Temperature: 27.0

(A) Schematic1.dat (active)



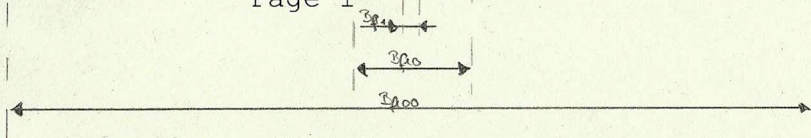
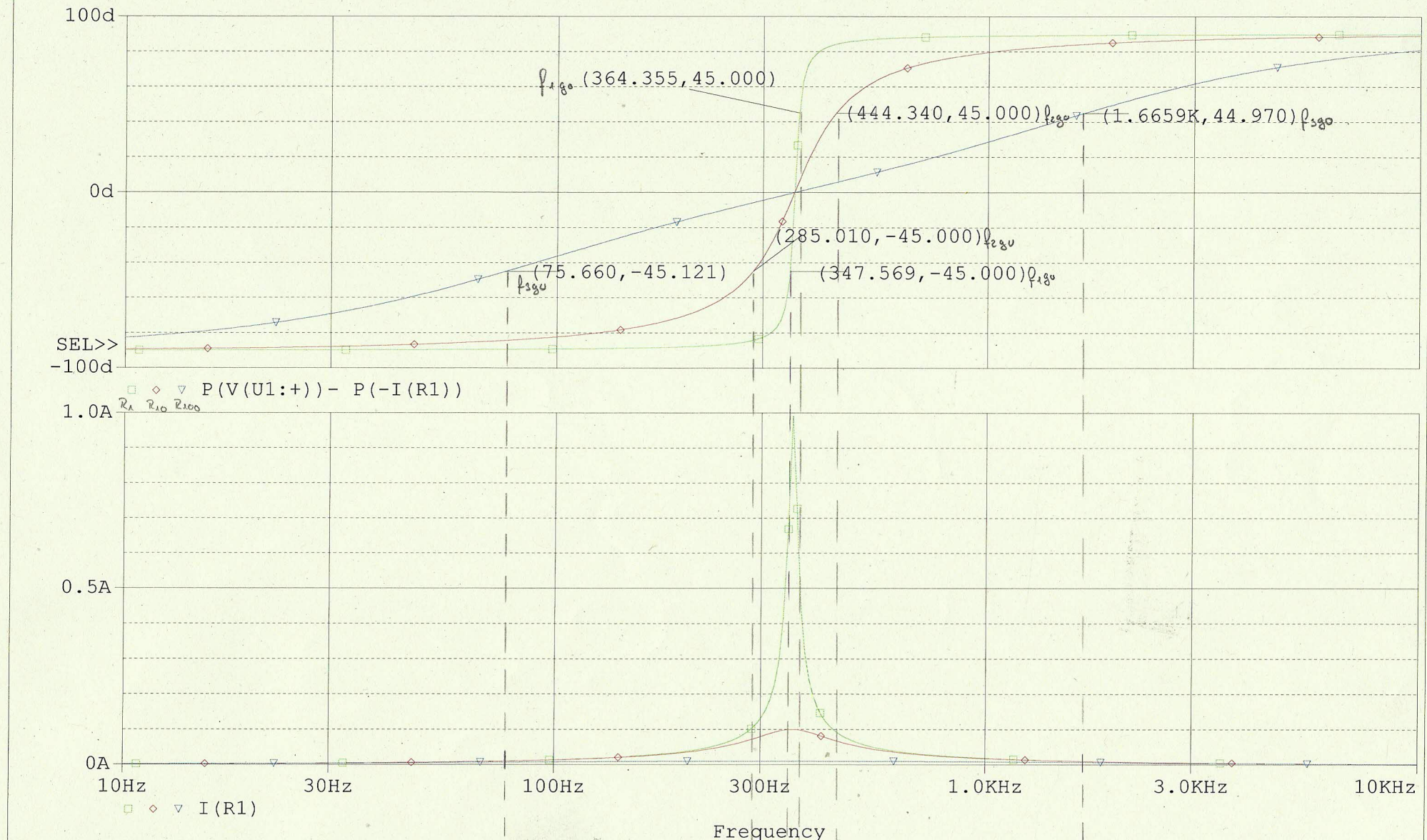
1a) Plot 3

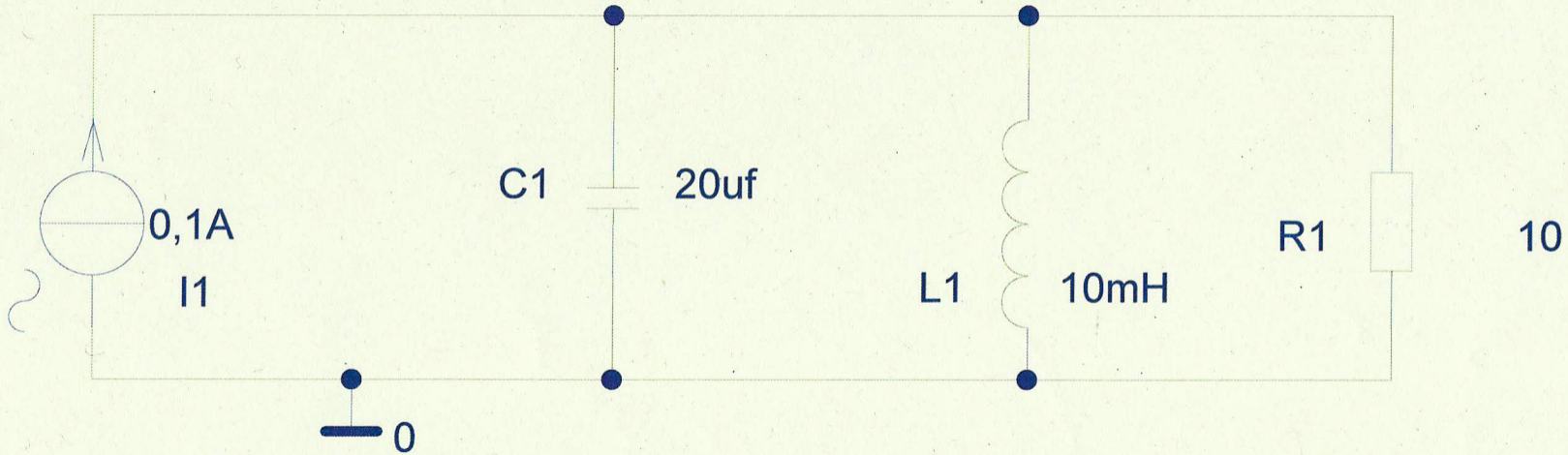
(A) Schematic1.dat (active)



10) Plot 4

(A) Schematic1.dat (active)

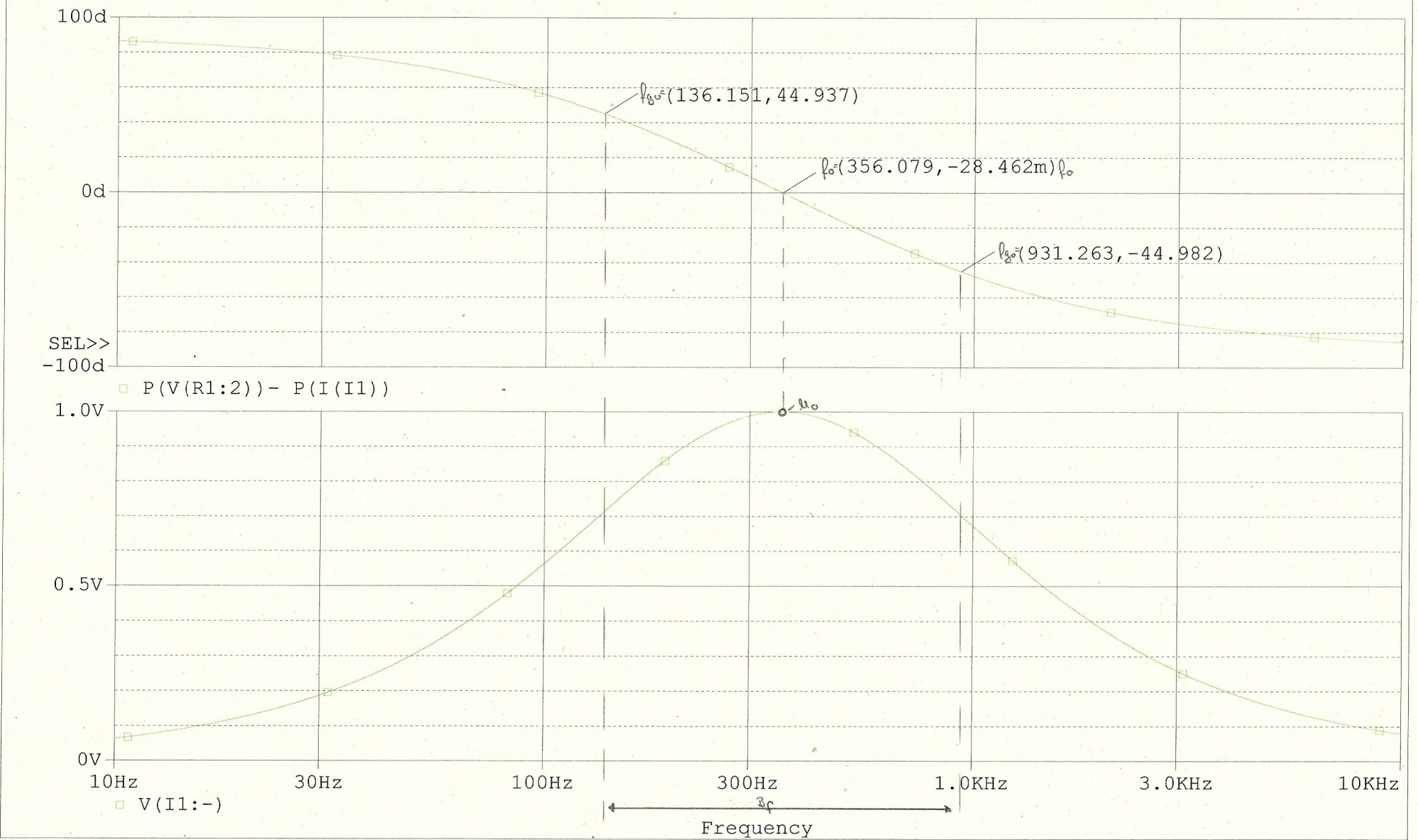


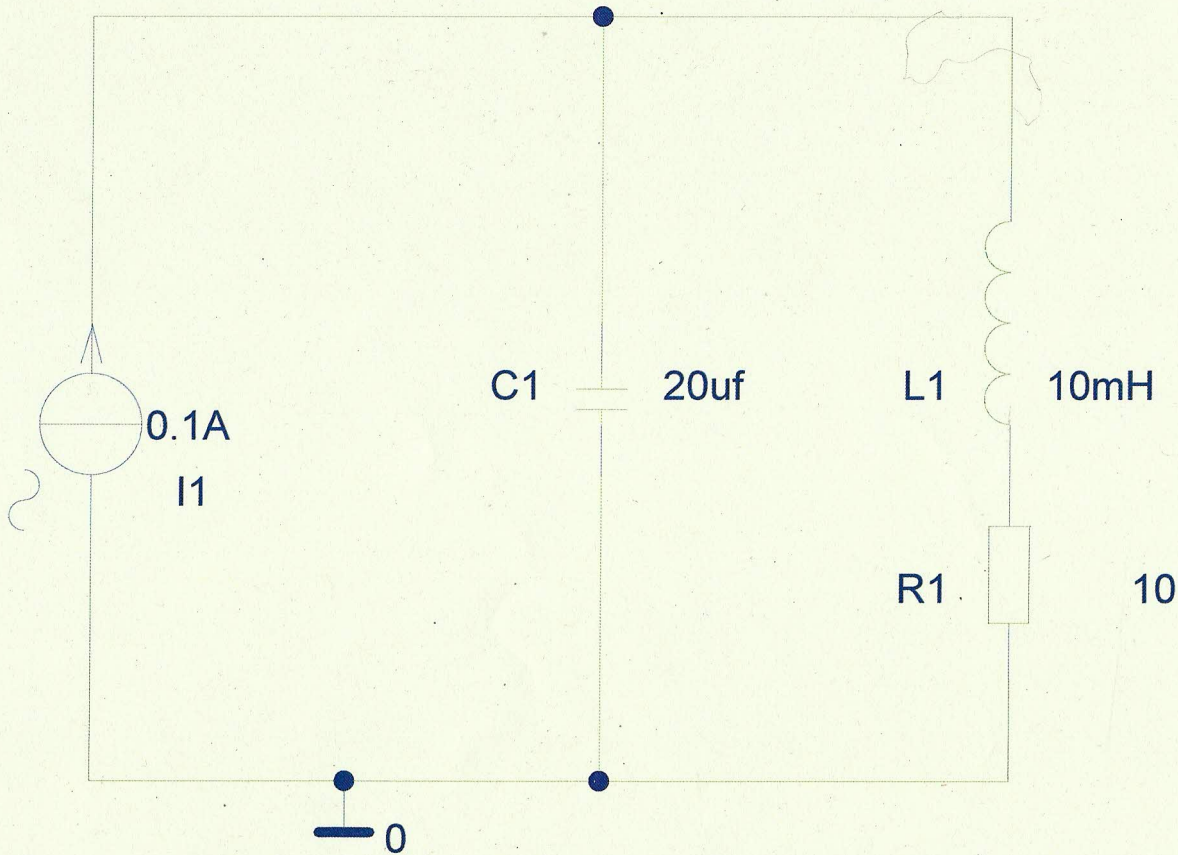


2) Plot 5

6

(A) Schematic1.dat (active)





3) Plot G

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Temperature: 27.0

(A) Schematic1.dat (active)

