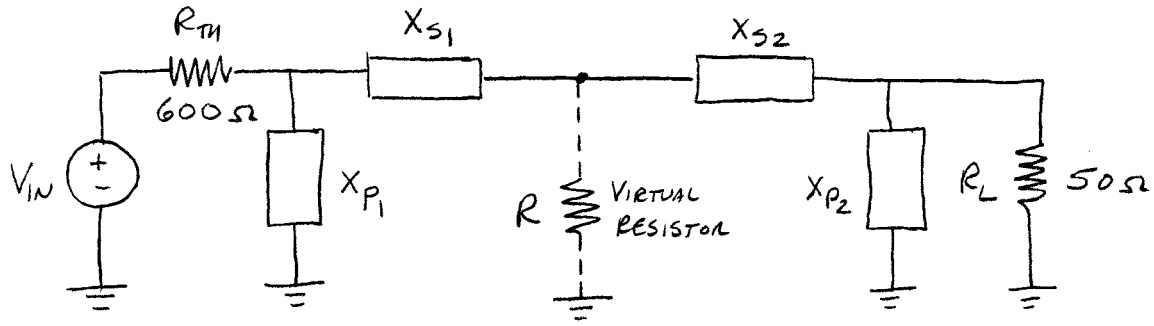
ECE 404 - HW # 7 - SOLUTION - 30 PTS

1)



$$Q = 2Q_0 = 20$$

$$R = \frac{R_H}{Q^2+1} = \frac{600}{20^2+1} = \frac{600}{401} = 1.49626\,\Omega$$

$$Q = \frac{R_{TH}}{X_{P1}} \Rightarrow X_{P1} = \frac{R_{TH}}{Q} = \frac{600}{20} = 30\,\Omega$$

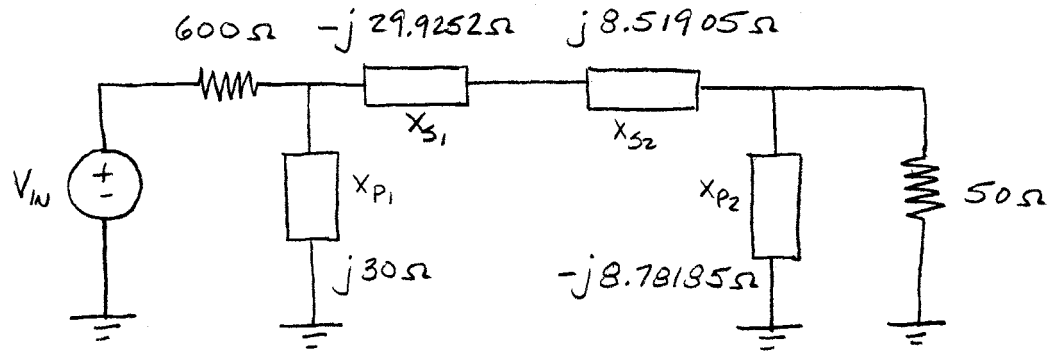
$$Q = \frac{X_{S1}}{R} \Rightarrow X_{S1} = QR = 20(1.49626) = 29.9252\,\Omega$$

$$Q_{RIGHT} = \sqrt{\frac{R_L}{R} - 1} = \sqrt{\frac{50}{1.49626} - 1} = 5.69356$$

$$Q_{RIGHT} = \frac{R_L}{X_{P2}} \Rightarrow X_{P2} = \frac{R_L}{Q_{RIGHT}} = \frac{50}{5.69356} = 8.78185\,\Omega$$

$$Q_{RIGHT} = \frac{X_{S2}}{R} \Rightarrow X_{S2} = RQ_{RIGHT} = (1.49626)(5.69356) = 8.51905\,\Omega$$

DESIGN III

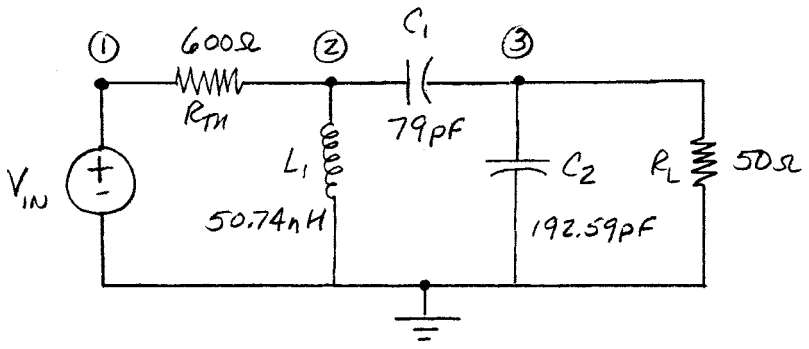


$$\therefore L_1 = \frac{30}{2\pi(94.1M)} = 50.74\ nH$$

$$\therefore C_2 = \frac{1}{2\pi(94.1M)\,8.78185} = 192.59\ pF$$

$$-j29.9252 + j8.51905 = -j21.4062\ \Omega$$

$$\therefore C_1 = \frac{1}{2\pi(94.1M)(21.4062)} = 79\ pF$$



2)

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PI Matching Network
VIN 1 0 AC 1
RTH 1 2 600
L1 2 0 50.74N
C1 2 3 79P
C2 3 0 192.59P
RL 3 0 50
.PROBE
.AC DEC 5000 1MEG 10G
.END
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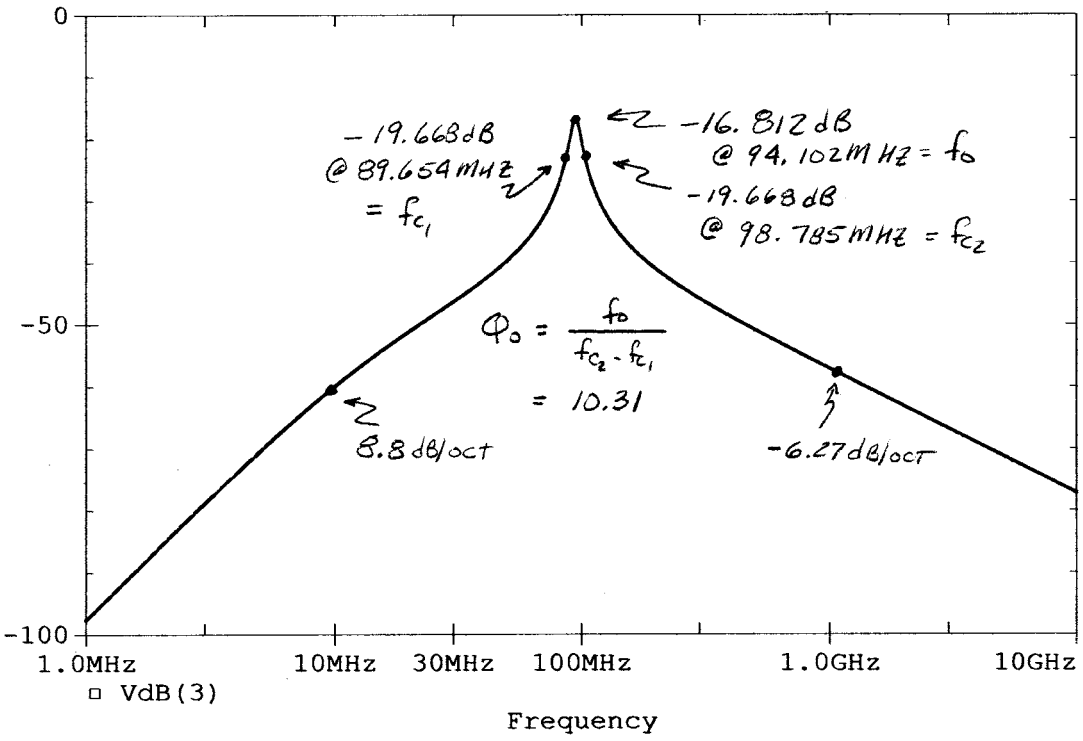
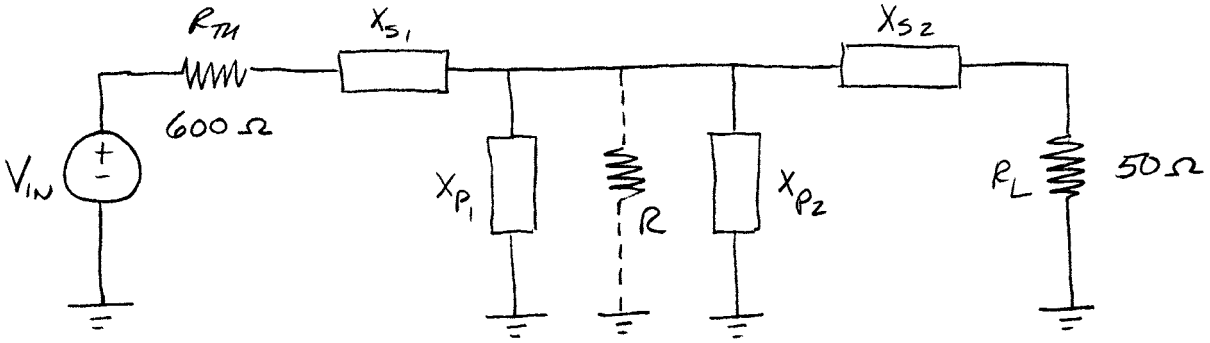
PI Matching Network Temperature: 27.0



- FOR HIGH FREQ., L_1 IS AN OPEN AND C_1 IS A SHORT WHICH HAVE NO EFFECT ON V_3. BUT C_2 IS A SHORT RESULTING IN A DECREASE BY 3'. THIS CAUSES THE SLOPE TO BE 20dB/DEC OR 6dB/OCT.

- FOR LOW FREQ., L_1 IS A SHORT AND C_1 IS AN OPEN. SO TWO IMPEDANCES ARE PULLING V_3 DOWN. C_2 IS AN OPEN AND HAS NO EFFECT. THUS THE SLOPE IS -40dB/DEC OR -12dB/OCT.

3)



$$Q = 2Q_0 = 20$$

$$R = R_{L0}(Q^2+1) = 50(20^2+1) = 20.05\,K\Omega$$

$$Q = \frac{X_{S2}}{R_L} \Rightarrow X_{S2} = QR_L = (20)(50) = 1K\Omega$$

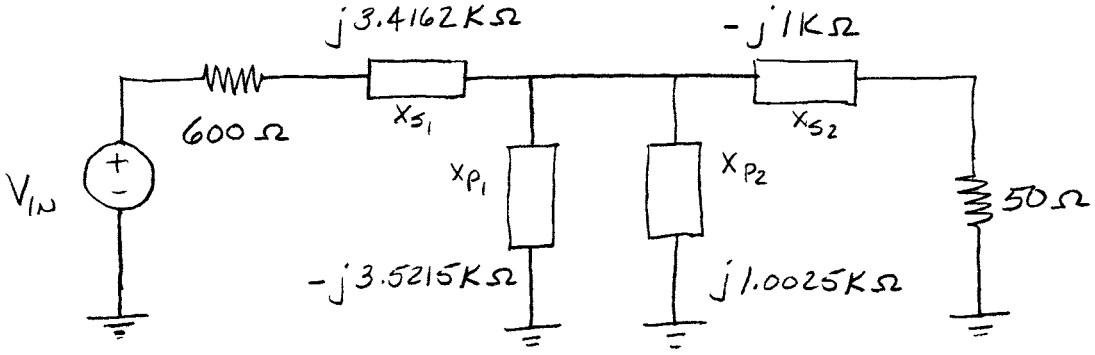
$$Q = \frac{R}{X_{P2}} \Rightarrow X_{P2} = \frac{R}{Q} = \frac{20.05K}{20} = 1.0025\,K\Omega$$

$$Q_{LEFT} = \sqrt{\frac{R}{R_{TH}} - 1} = \sqrt{\frac{20.05K}{600} - 1} = 5.6936\,\Omega$$

$$Q_{LEFT} = \frac{R}{X_{P1}} \Rightarrow X_{P1} = \frac{R}{Q_{LEFT}} = \frac{20.05K}{5.6936} = 3.5215\,K\Omega$$

$$Q_{LEFT} = \frac{X_{S1}}{R_{TH}} \Rightarrow X_{S1} = R_{TH}Q_{LEFT} = (600)(5.6936) = 3.4162\,K\Omega$$

DESIGN III

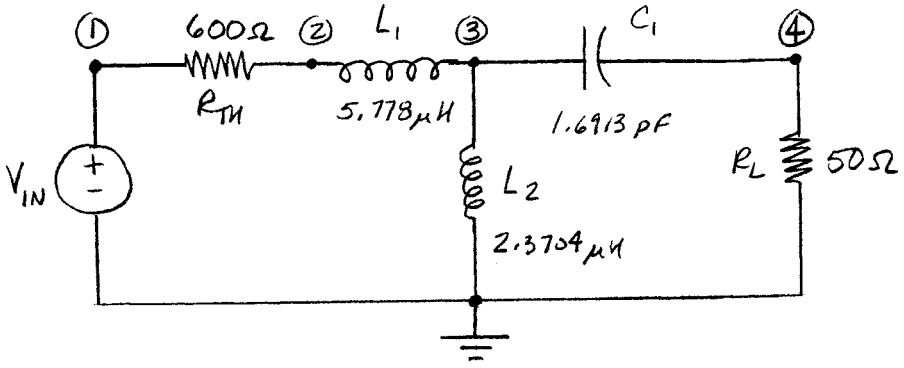


$$\therefore \quad L_1 = \frac{3.4162K}{2\pi(94.1m)} = 5.778\mu H$$

$$\therefore \quad C_1 = \frac{1}{2\pi(94.1m)(1K)} = 1.6913\,pF$$

$$\frac{(-j3.5215)(j1.0025)}{-j3.5215 + j1.0025} = j1.4015K$$

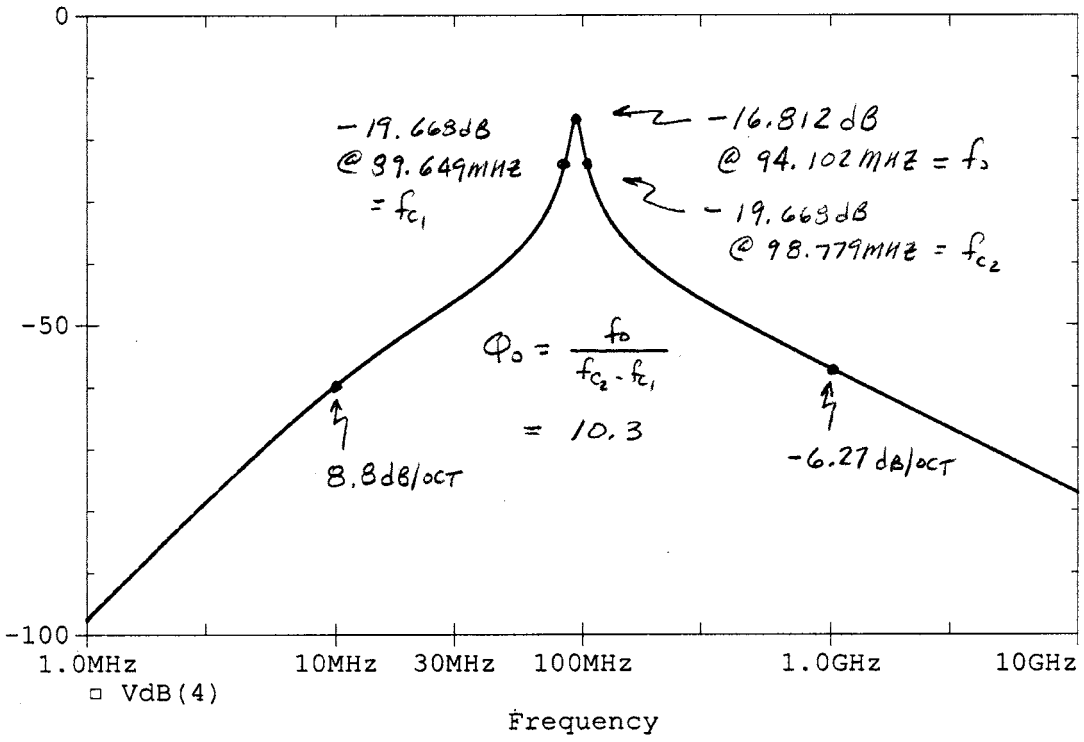
$$\therefore \quad L_2 = \frac{1.4015K}{2\pi(94.1m)} = 2.3704\mu H$$



4)

```
T Matching Network
VIN 1 0 AC 1
RTH 1 2 600
L1  2 3 5.778U
L2  3 0 2.3704U
C1  3 4 1.6913P
RL  4 0 50
.PROBE
.AC DEC 5000 1MEG 10G
.END
```

T Matching Network Temperature: 27.0



- FOR HIGH FREQ., L_2 IS AN OPEN AND C_1 IS A SHORT WHICH HAVE NO EFFECT ON V_4. BUT L_1 IS AN OPEN RESULTING IN A DECREASE BY s^1. THIS CAUSES THE SLOPE TO BE 20 dB/DEC OR 6 dB/OCT

- FOR LOW FREQ., L_2 IS A SHORT AND C_1 IS AN OPEN. SO TWO IMPEDANCES ARE PULLING V_4 DOWN. L_1 IS A SHORT AND HAS NO EFFECT. THUS THE SLOPE IS -40 dB/DEC OR -12 dB/OCT.