D3TT 2013

2. Impedance Matching

a. Rancanglah sebuah penyesuai impedansi topologi L, untuk menyesuaikan impedansi beban $Z_L = (30 - j20)\Omega$ ke impedansi sumber $Z_S = (50 + j10)\Omega$. Diinginkan **komponen seri dari matching network berupa induktor**, $f = 100$ MHz !

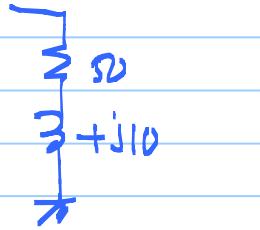
$R_s > R_L \Rightarrow 50 > 30$

→ IMC L kanan maka paralel di sumber

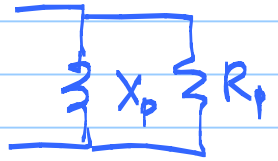
Absorbsi

a. $Z_s = 50 + j10$ → ubah ke paralel

$Z_L = 30 - j20$



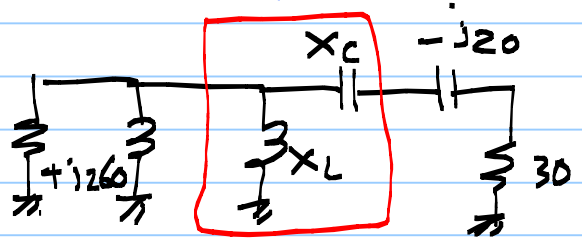
$\Rightarrow$



$Q_s = \frac{X_s}{R_s} = \frac{10}{50} = 0{,}2$

$R_p = R_s(1+Q^2) = 50(1+0{,}2^2) = 52$

$X_p = X_s\left(1+\frac{1}{Q^2}\right) = 10\left(1+\frac{1}{0{,}2^2}\right) = 260$



$Q = \sqrt{\frac{52}{30} - 1} = 0{,}86$

Dari sisi sumber :

$Q_p = \frac{R_p}{X_p} \Rightarrow X_p = \frac{R_p}{Q} = \frac{52}{0{,}86}$

$X_p = 60{,}5$

$$X_{Lt} = +j60,5 \Rightarrow X_{Lt} = \frac{X_L \cdot 260}{260 + X_L} = 60,5 \Rightarrow 15730 + 60,5X_L = 260X_L \Rightarrow X_L = \frac{15730}{260 - 60,5} = 78,85$$

$$X_L = 78,85$$

$$L = \frac{78,85}{\omega} = \frac{78,85}{2\pi 150.10^6} = 125,5\ nH$$

Dari sisi beban :

$$Q_s = \frac{X_s}{R_s} \Rightarrow X_s = Q \times R_s = 0,86 \times 30 = 25,8$$

$$-jX_{ct} = -j25,8 = -jX_c - j20 \Rightarrow X_c = 5,8$$

$$C = \frac{1}{5,8 \cdot 2\pi \cdot 150.10^6} = 274,4\ pF$$

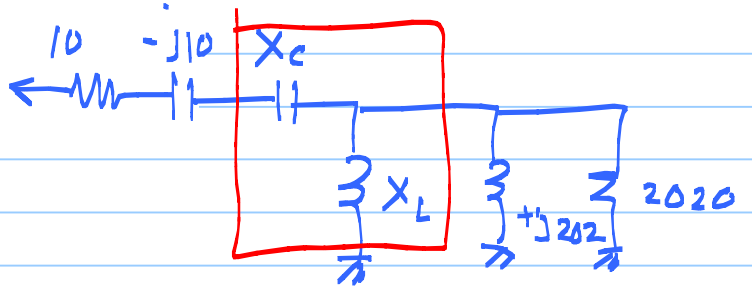
SITT 2010

2. Impedance Matching

Rangkaian penyesuai impendasi (IMC) **tipe L** bersifat **HPF** dirancang pada frekuensi kerja 2 MHz untuk menyepadankan $Z_S = (10 - j10)\ \Omega$ dan $Z_L = (20+j200)\ \Omega$.

a. Rancanglah rangkaian penyesuai impendasi tersebut dengan **metode Resonansi**!

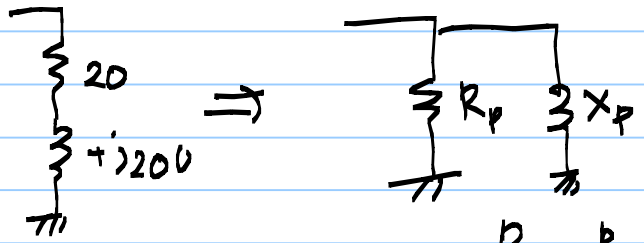
b. Rancanglah rangkaian penyesuai impendasi tersebut dengan **metode Absorbsi**!



b. $R_S < R_L \rightarrow 10 < 20 \rightarrow$ IMC L kiri HPF

$Z_S = 10 - j10$

$Z_L = 20 + j200 \rightarrow$ Ubah ke paralel



$Q_S = \frac{X_S}{R_S} = \frac{200}{20} = 10$

$R_p = R_S(1+Q^2) = 20(1+10^2) = 2020$

$X_p = X_S\left(1+\frac{1}{Q^2}\right) = 200\left(1+\frac{1}{10^2}\right) = 202$

Dari sisi sumber :

$Q = \sqrt{\frac{2020}{10} - 1} = 14{,}2$

$Q_S = \frac{X_S}{R_S} \rightarrow X_S = Q \times R_S = 14{,}2 \times 10$

$X_S = 142 \Rightarrow X_{ct} = 142$

$-jX_{ct} = -jX_c - j10 \Rightarrow X_c = 132$

$C = \frac{1}{2\pi \cdot 2 \cdot 10^6 \cdot 132} = 602{,}9\ pF$

$$Q_p = \frac{R_p}{X_p} \rightarrow X_p = \frac{R_p}{Q} = \frac{2020}{14,2} = 142,3$$

$$X_{Lt} = 142,3 \rightarrow X_{Lt} = \frac{X_L \cdot 202}{X_L + 202} = 142,3 \rightarrow 142,3X_L + 28744,6 = 202X_L$$

$$X_L = \frac{28744,6}{202 - 142,3} = 481,48$$

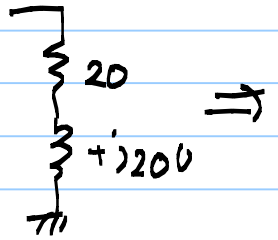
$$L = \frac{481,48}{2\pi\, 2.10^6} = \boxed{38,32\ \text{nH}}$$

$R_s < R_L \rightarrow 10 < 20 \rightarrow$ IMC L kiri HPF

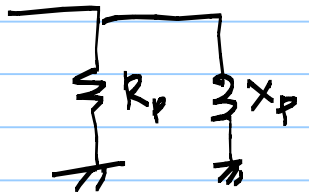
9.

$Z_s = 10 - j10$

$Z_L = 20 + j200 \rightarrow$ Ubah ke paralel



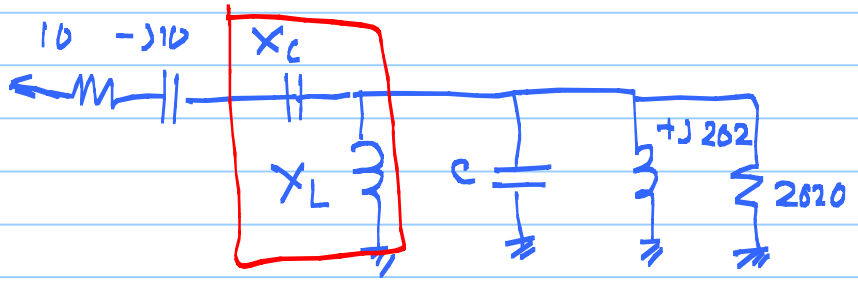
$\Rightarrow$



$$Q_s = \frac{X_s}{R_s} = \frac{200}{20} = 10$$

$$R_p = R_s(1 + Q^2) = 20(1 + 10^2) = 2020$$

$$X_p = X_s\left(1 + \frac{1}{Q^2}\right) = 200\left(1 + \frac{1}{10^2}\right) = 202$$



$$L = \frac{202}{\omega} = \frac{202}{2\pi \cdot 2.10^6} = 16,1\ \text{nH}$$

$$f = \frac{1}{2\pi\sqrt{LC}} \rightarrow C = \frac{1}{\omega^2 L}$$

$$C = \frac{1}{(2\pi \cdot 2 \cdot 10^6)^2 \cdot 16{,}1 \cdot 10^{-6}} = 393{,}3\ pF$$

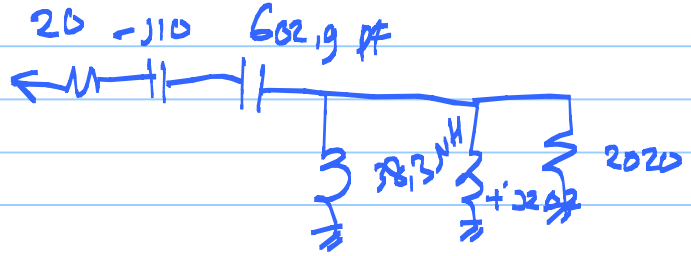
Dari segi sumber :

$$Q = \sqrt{\frac{2020}{10} - 1} = 14{,}2$$

$$Q_s = \frac{X_s}{R_s} \rightarrow X_s = Q \times R_s = 14{,}2 \times 10 = 142$$

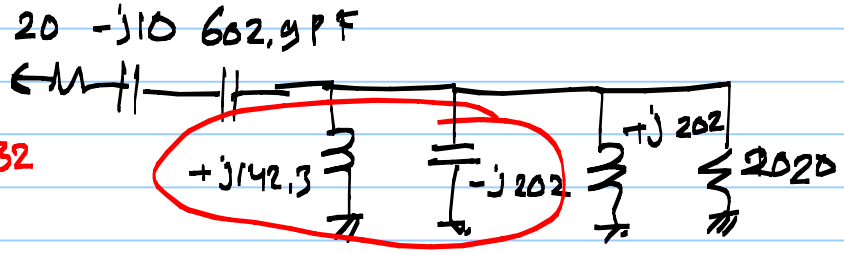
$$-jX_{Ct} = -j142 = -jX_c - j10 \rightarrow X_c = 132$$

$$C = \frac{1}{2\pi \cdot 2 \cdot 10^6 \cdot 132} = 602{,}9\ pF$$



$$Q_p = \frac{R_p}{X_p} \rightarrow X_p = \frac{R_p}{Q} = \frac{2020}{14{,}2} = 142{,}3$$

$$X_L = +j142{,}3$$



$$X_p = \frac{+j142{,}3 \times (-j202)}{+j142{,}3 - j202} = +j481{,}5$$

$$L = \frac{481{,}5}{2\pi \cdot 2 \cdot 10^6} = 38{,}3\ \mu H$$

2. **Impedance Matching**

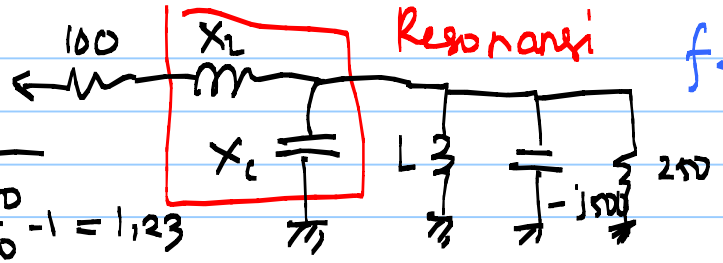
Rangkaian penyesuai impendasi (IMC) **tipe L-section** dirancang pada frekuensi kerja 2 MHz bersifat **LPF** dan **HPF** untuk menyepadankan saluran transmisi dengan impedansi intrinsik Z_o= **100 Ω** dan antena dengan impedansi Z_{Ant} = **(200-j100) Ω**. ketentuan pengerjaan sebagai berikut :

- Untuk **NIM nomor ganjil** harus menggunakan **metode Resonansi** dan
- Untuk **NIM nomor genap** harus menggunakan **metode Absorbsi**.

a. Tulislah langkah-langkah perancangan IMC sesuai dengan **metode/NIM** anda, termasuk konversi dari seri ke parallel pada beban jika diperlukan !

b. Rancanglah rangkaian penyesuai impendasi tersebut dan rangkaian harus **bersifat LPF** !

c. Rancanglah rangkaian penyesuai impendasi tersebut dan rangkaian harus **bersifat HPF** !



Resonansi

$f = \frac{1}{2\pi\sqrt{LC}}$

$L = \frac{1}{\omega^2 C}$

$= 39{,}8\ \mu H$

$Q = \sqrt{\frac{250}{100} - 1} = 1{,}23$

$Q_S = \frac{X_S}{R_S} \rightarrow X_S = Q \times R_S$

$= 1{,}23 \times 100 = 123$

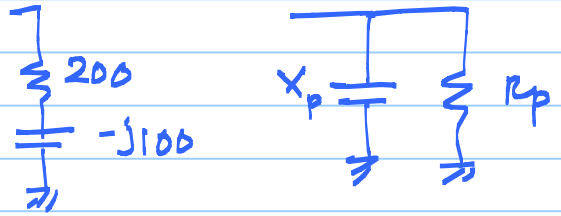
$L_{SAT} = 123 / 2\pi . 2.10^6 =$ **9,79 μH**

$Z_S = 100\ \Omega$

$Z_L = 200 - j100$

$R_S < R_L \rightarrow$ IMC L kiri

Z_L ubah ke paralel :



$Q_S = \frac{X_S}{R_S} = \frac{100}{200}$

$Q = 0{,}5$

$R_p = R_S (1 + Q^2) = 250$

$X_p = X_S \left(1 + \frac{1}{Q^2}\right) = 500$

$C = \frac{1}{2\pi . 2.10^6 . 500}$

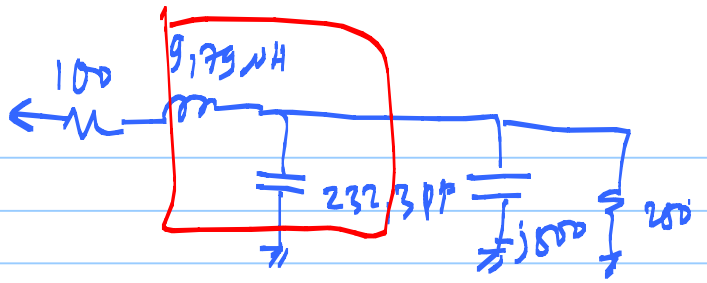
$= 159{,}2\ pF$

$$Q_p = \frac{R_p}{X_p} \rightarrow X_p = \frac{R_p}{Q} = \frac{250}{1{,}123} = 203{,}3$$

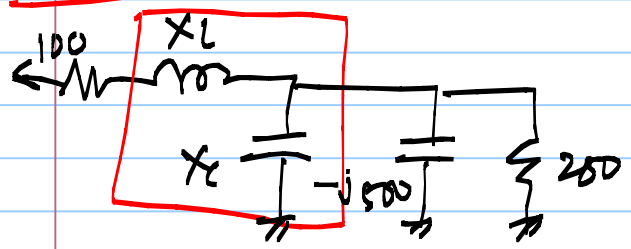
$$X_c = -j203{,}3$$

$$X_p' = \frac{-j203{,}3 \times j500}{-j203{,}3 + j500} = -j342{,}6$$

$$C = \frac{1}{2\pi . 2.10^6 . 342{,}6} = \boxed{232{,}3\ pF}$$



Absorbo



$$C = 159{,}2\ pF$$

$$Q = \sqrt{\frac{250}{100} - 1} = 1{,}23$$

$$Q_s = \frac{X_s}{R_s} \rightarrow X_s = Q \times R_s = 1{,}23 \times 100 = 123$$

$$X_L = 123$$

$$L = \frac{123}{2\pi . 2.10^6} = \boxed{9{,}79\ nH}$$

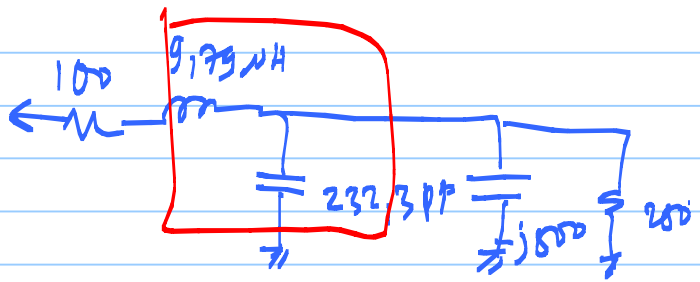
$$Q_p = \frac{R_p}{X_p} \rightarrow X_p = \frac{R_p}{Q} = \frac{250}{1{,}123}$$

$$X_p = 203{,}3$$

$$C = \frac{1}{2\pi . 2.10^6 . 203{,}3}$$

$$= 391{,}4\ pF$$

$C_{paralel\ IMC} = 391{,}4 - 159{,}2 =$ **232,2 pF**



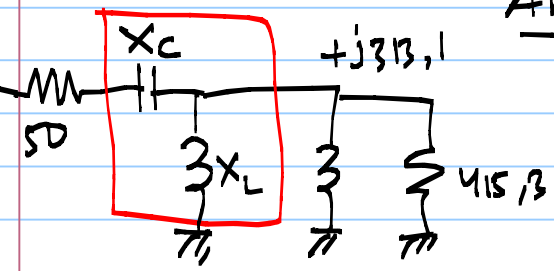
SITT 2007

2. Rancanglah sebuah **IMC-2 elemen** yang berfungsi untuk menyesuaikan **saluran transmisi** dengan impedansi karakteristik sebesar **= 50 Ω** ke impedansi beban antena sebesar **(150+j 200) Ω** ! Rangkaian bekerja pada frekuensi **450 MHz** bersifat **menghambat sinyal DC**.

$Z_s = 50$

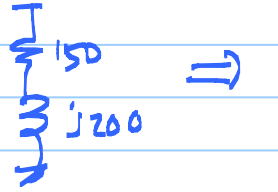
$Z_L = 150 + j200$ → ubah ke paralel

$R_s < R_L$ → IMC L ke HPF

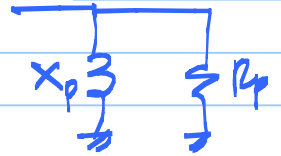


Absorbsi

$Q = \sqrt{\frac{415,3}{50} - 1} = 2,7$



$\Rightarrow$



$Q_s = \frac{X_s}{R_s} = \frac{200}{150} = 1,33$

$R_p = R_s(1+Q^2)$
$= 150(1+1,33^2) = 415,3$

$X_p = X_s\left(1+\frac{1}{Q^2}\right)$
$= 200\left(1+\frac{1}{1,33^2}\right) = 313,1$

$Q_s = \frac{X_s}{R_s} \rightarrow X_s = Q \times R_s = 2,7 \times 50 = 135$

$X_c = 135$

$C = \frac{1}{2\pi \cdot 450.10^6 \cdot 135}$

C = 2,62 pF

$Q_p = \frac{R_p}{X_p} \rightarrow X_p = \frac{R_p}{Q} = \frac{415,3}{2,7}$

$X_p = 153,8$

$X_{Lt} = \frac{X_L \cdot 313,1}{X_L + 313,1} = 153,8$

$X_L = \frac{48154,78}{313,1 - 153,8} = 302,3$

$L = 302,3 / 2\pi \cdot 450.10^6 = 106,9$ nH