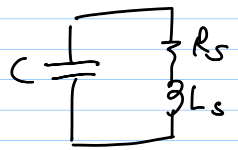
5-8-13

Lec 3

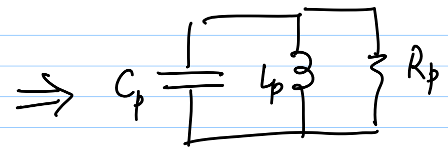
* 50Ω impedance is the RF std.
  → don't drive 50Ω on-chip
* Chip boundary – match to 50Ω

Impedance Xformation



neither Series nor $\parallel^l$

@ resonance – do series to parallel conv.



$C_p = C$

$$R_s + j\omega_0 L_s = \frac{R_p \cdot j\omega_0 L_p}{R_p + j\omega_0 L_p}$$

$$= \frac{(\omega_0 L_p)^2 \cdot R_p + j\omega_0 L_p R_p^2}{R_p^2 + \omega_0^2 L_p^2}$$

Equate real parts

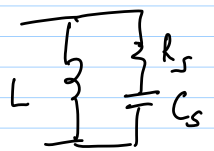
$$R_s = \frac{(\omega_0 L_p)^2 \cdot R_p}{R_p^2 + (\omega_0 L_p)^2}$$

Im part

$$\omega_0 L_s = \frac{\omega_0 L_p R_p^2}{R_p^2 + (\omega_0 L_p)^2}$$

$$Q_s = \frac{\omega_0 L_s}{R_s} \; ; \; Q_p = \frac{R_p}{\omega_0 L_p} \; ; \; Q_p = Q_s = Q$$

$$R_p = R_s(1+Q^2) \; ; \; L_p = \frac{L_s(1+Q^2)}{Q^2}$$



$$\Rightarrow C_p = \frac{C_s \cdot Q^2}{1+Q^2}$$

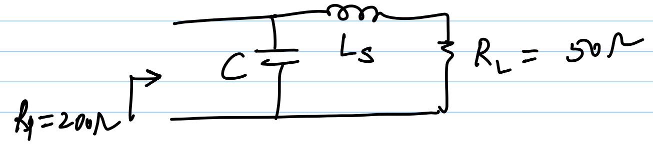
Impedance matching

discrete RF

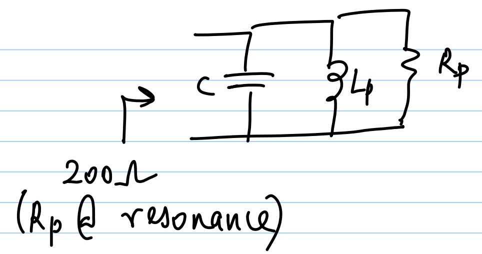
1) $\lambda/4$ Xfmr.
2) Stub matching
3) Xfmr

L-match networks

Upward Xformation



"Low-pass" L-match



$$L_p = \frac{L_s(1+Q^2)}{Q^2}$$

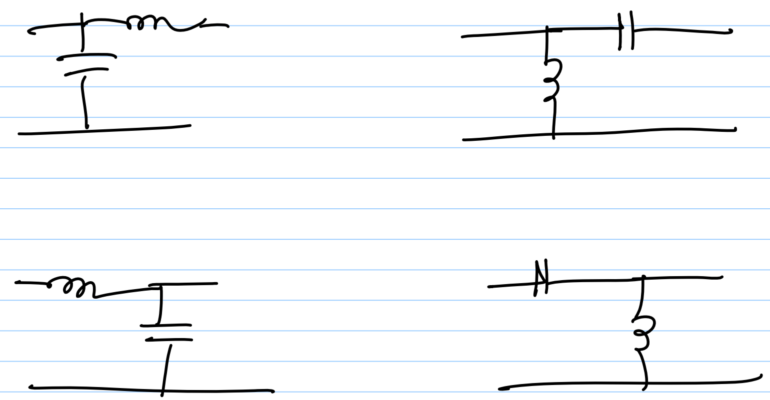
$$R_p = R_s(1+Q^2)$$

$$Q = \sqrt{\frac{R_p}{R_s} - 1} = \sqrt{3} = 1.732$$

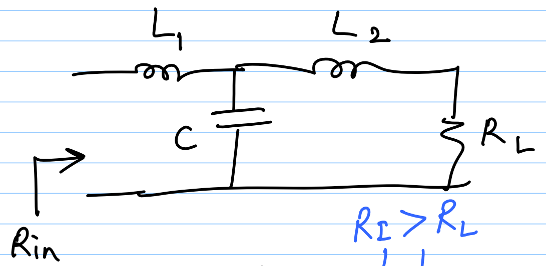
$\frac{\omega_0}{2\pi}$ = freq. of operation (known)

from $Q, \omega_0, R_p, R_s \Rightarrow L_s$ & L_p are known

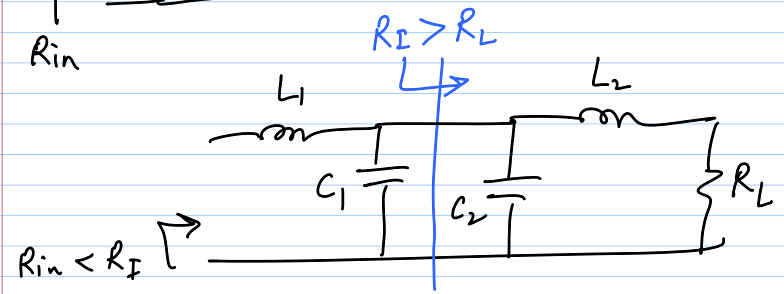
$$\omega_0 = \frac{1}{\sqrt{CL_p}} \Rightarrow \text{find } C$$



To design for BW, need 3rd degree of freedom – design for Q S.



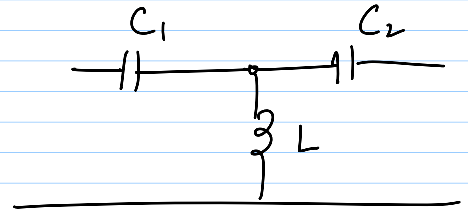
T-match



$\omega_0, R_{in}/R_s, Q$

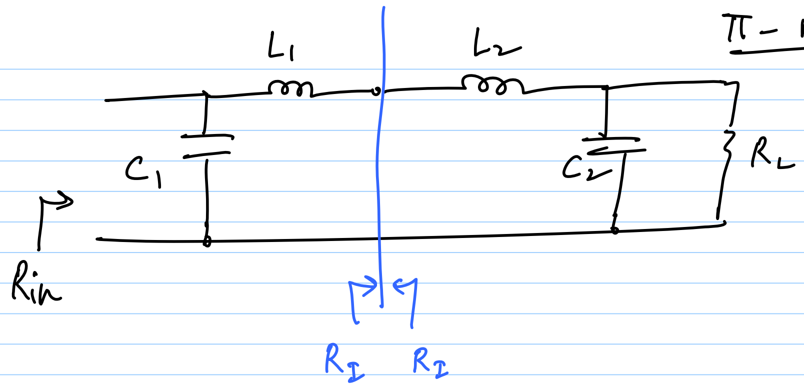
$Q = Q_L + Q_R$ ✓

$$Q = \sqrt{\frac{R_I}{R_{in}} - 1} + \sqrt{\frac{R_I}{R_L} - 1}$$

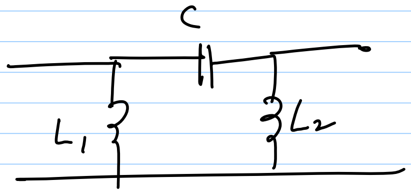


HP T-match

π – match



$R_I < R_{in}$; $R_I < R_L$



1) Q – choose between L & T/π
2) Low-pass or High-pass
3) Area – # of components
   – # of L's
   – value of L's & C's
4) Insertion loss – loss in the components (L's have low Q)