Aula 09

segunda-feira, 18 de outubro de 2021 16:23

A sonda de RMN

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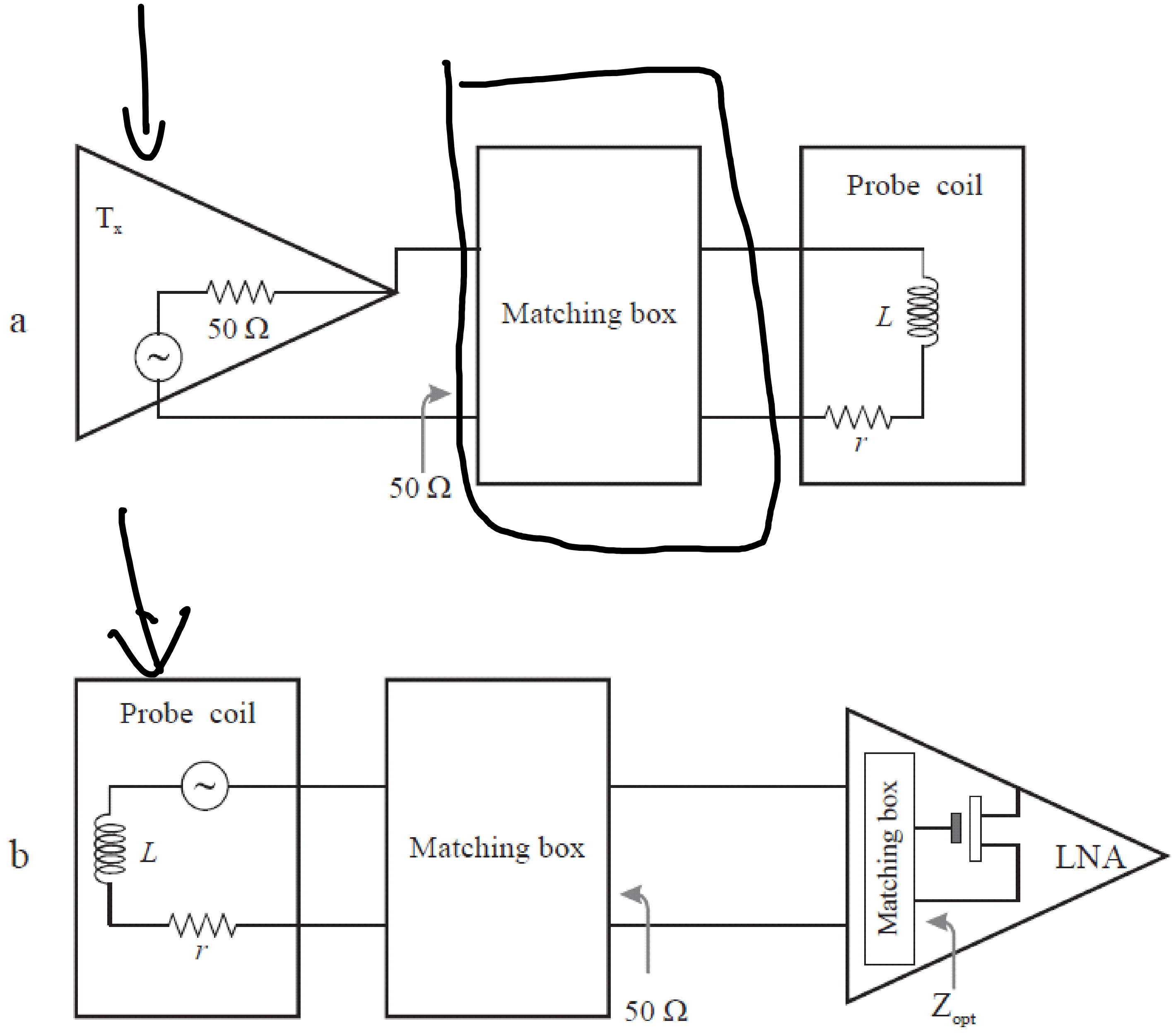
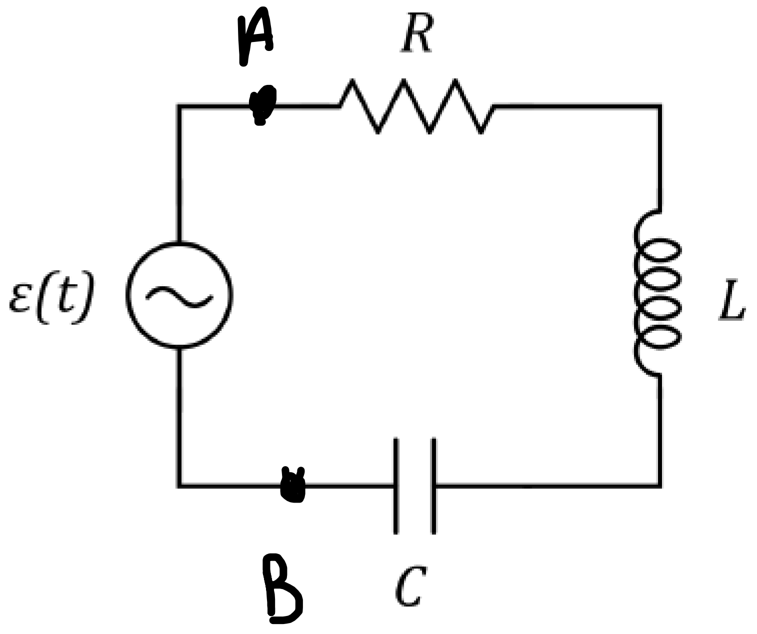
O que é uma sonda

Equipamento para detecção de campos magnéticos oscilantes - Indução de Faraday

- Utilizada tanto para excitação da amostra quanto para recepção do sinal.
- Nada mais do que uma bonina "interfaceada" com o equipamento de RF de forma que haja casamento de impedâncias.
- À uma dada frequência, a sonda deve ter a mesma impedância (usualmente 50 Ω) que o equipamento de rf para que haja máxima transferência de energia.



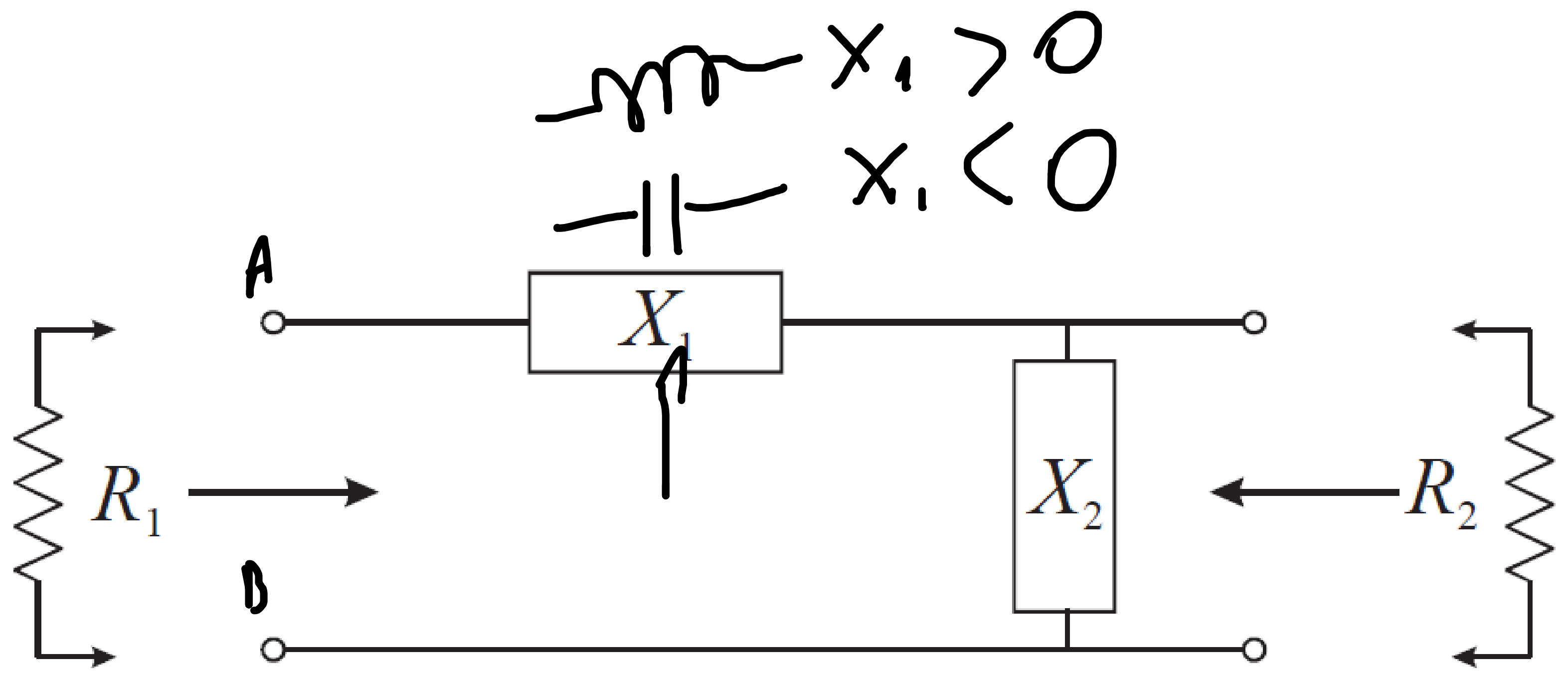
Circuito RLC



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

$$\omega = \frac{1}{\sqrt{LC}}$$

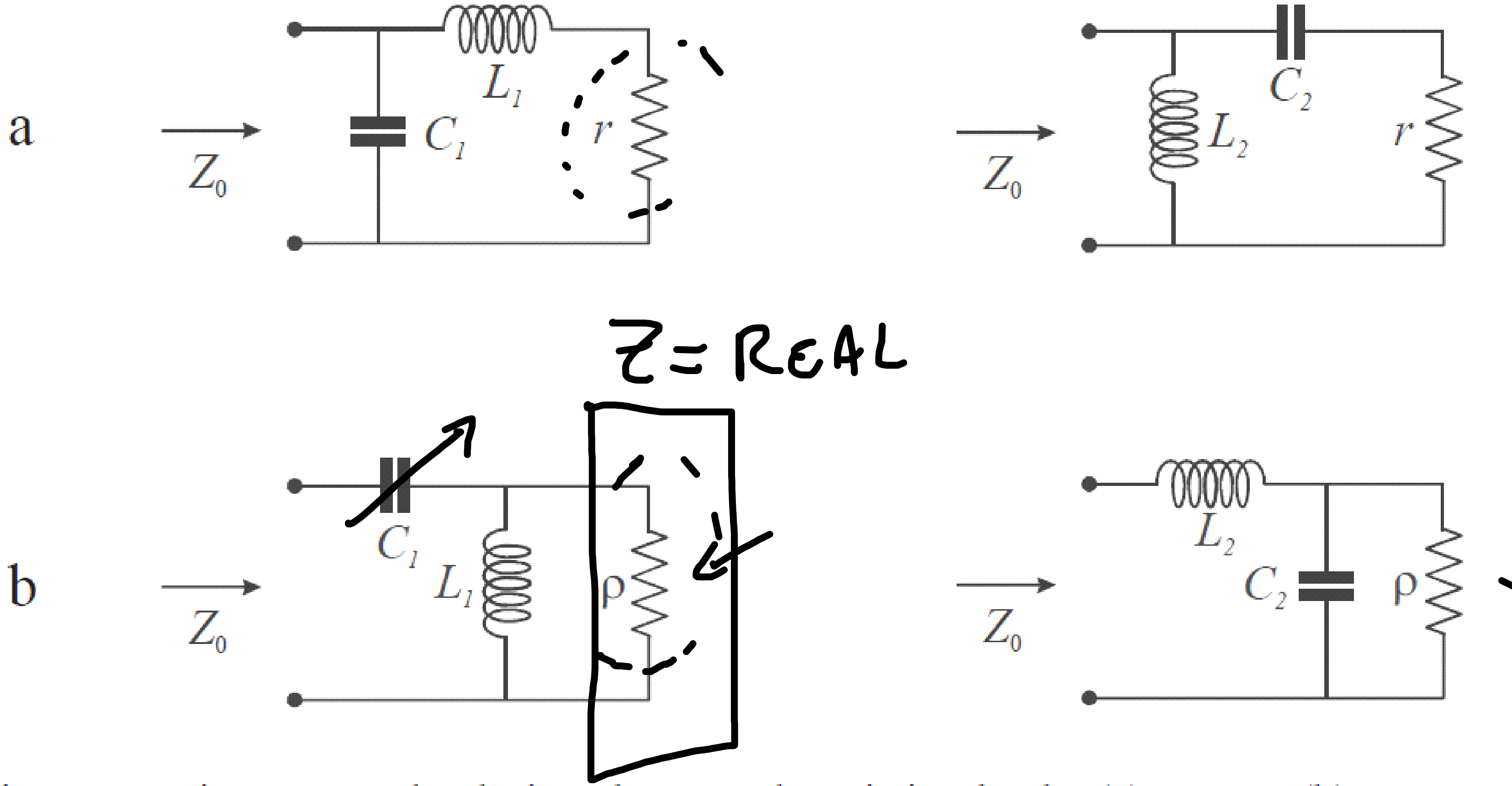
L-matching



$$
\begin{cases}
p = R_2 / R_1 \\
X_1 = \pm R_1 \sqrt{p-1} \\
X_2 = \mp R_2 / \sqrt{p-1}
\end{cases}
$$

$R_2 > R_1$

Tipos de circuito L-matching



$$\boxed{\begin{aligned} L_1\omega_S &= \frac{1}{C_2\omega_S} = \sqrt{r\left(Z_0 - r\right)} \\ \frac{1}{C_1\omega_S} &= L_2\omega_S = Z_0\sqrt{\frac{r}{Z_0 - r}} \end{aligned}}$$

$r \rightarrow R_1$

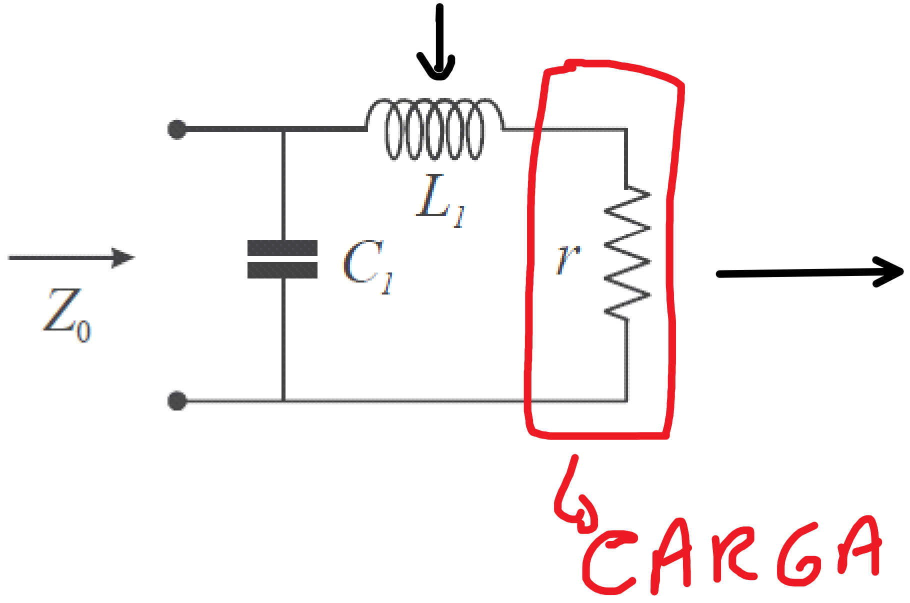
$\rho \rightarrow R_2$

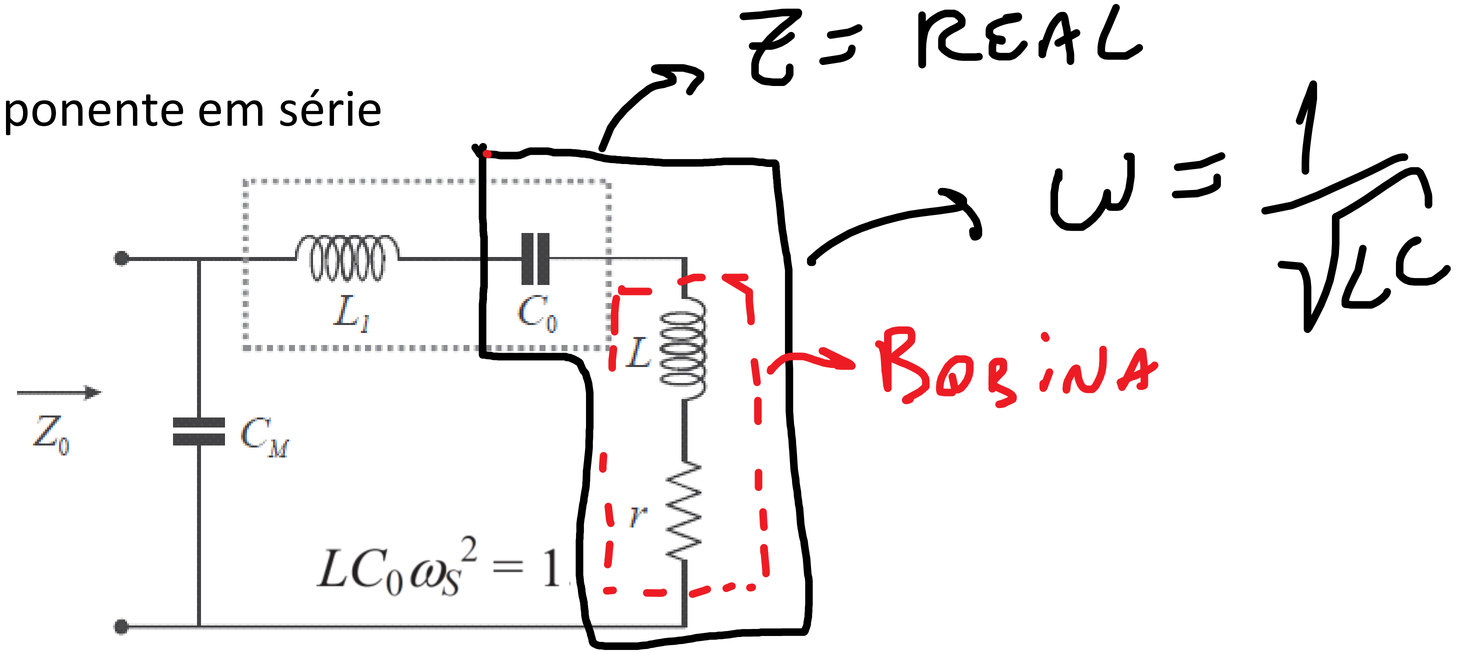
$$\boxed{\begin{aligned} L_1\omega_S &= \frac{1}{C_2\omega_S} = \rho\sqrt{\frac{Z_0}{\rho - Z_0}} \\ \frac{1}{C_1\omega_S} &= L_2\omega_S = \sqrt{Z_0\left(\rho - Z_0\right)} \end{aligned}}$$

Fig. 4.4 Basic L-networks designed to match resistive loads. (a) $r < Z_0$. (b) $\rho > Z_0$. The input impedance can be either capacitive (left), or inductive (right).

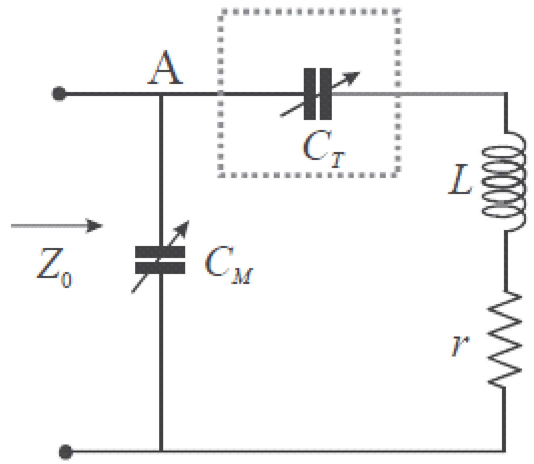
Tunning em série e matching em paralelo

A indutância da bobina é cancelada por um componente em série





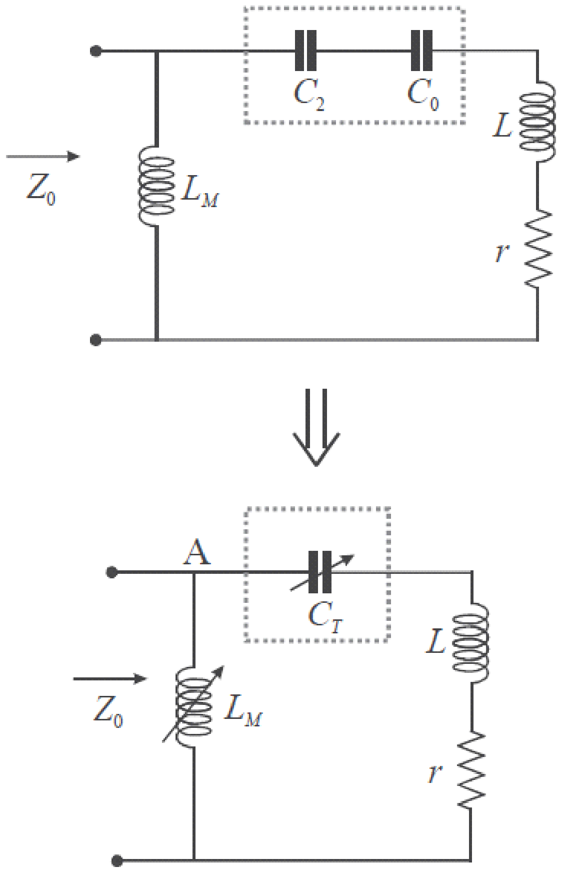
$\Downarrow$



$$\frac{1}{C_M\omega_S} = Z_0\sqrt{\frac{r}{Z_0 - r}}$$

$$\frac{1}{C_T\omega_S} = L\omega_S - \sqrt{r\left(Z_0 - r\right)}$$

Outra configuração



$$L_M \omega_S = Z_0 \sqrt{\frac{r}{Z_0 - r}}.$$

$$\frac{1}{C_T \omega_S} = L\omega_S + \sqrt{r\left(Z_0 - r\right)}$$

Tunning em paralelo e matching em série

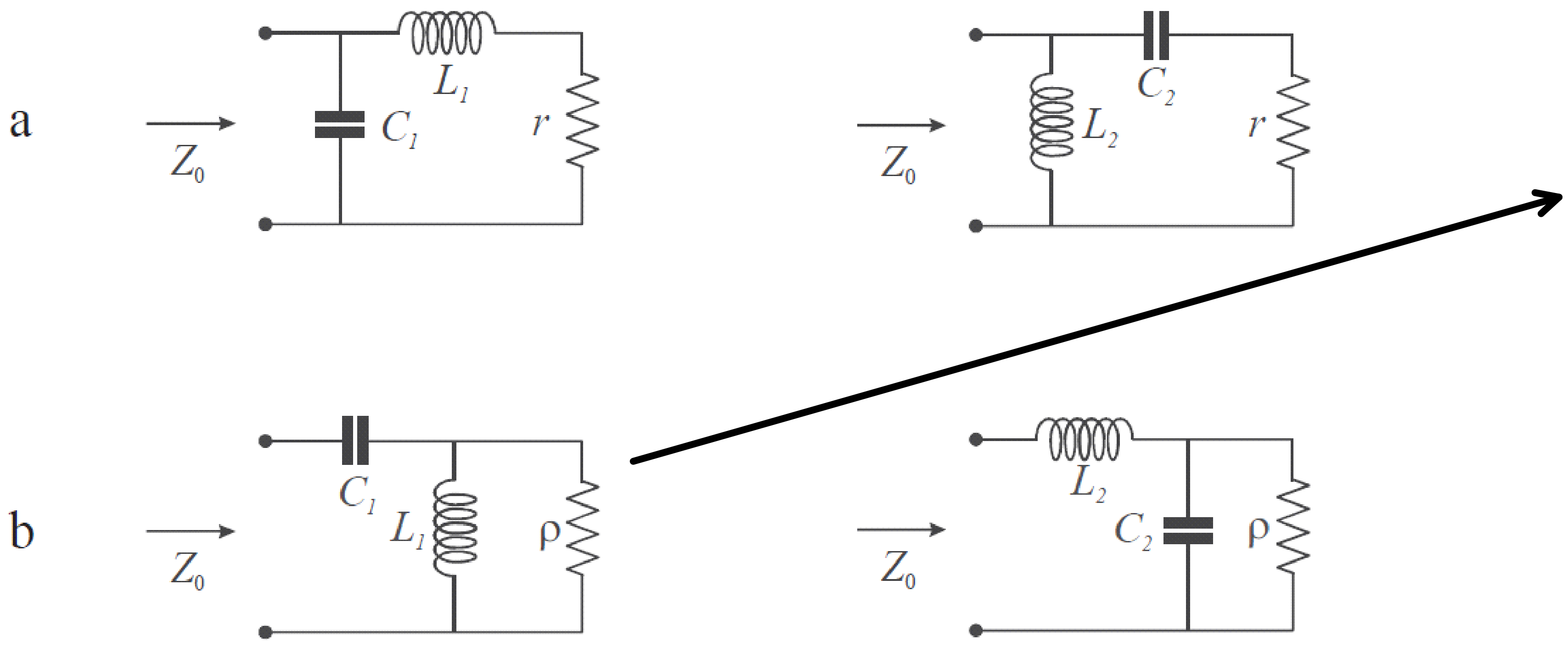
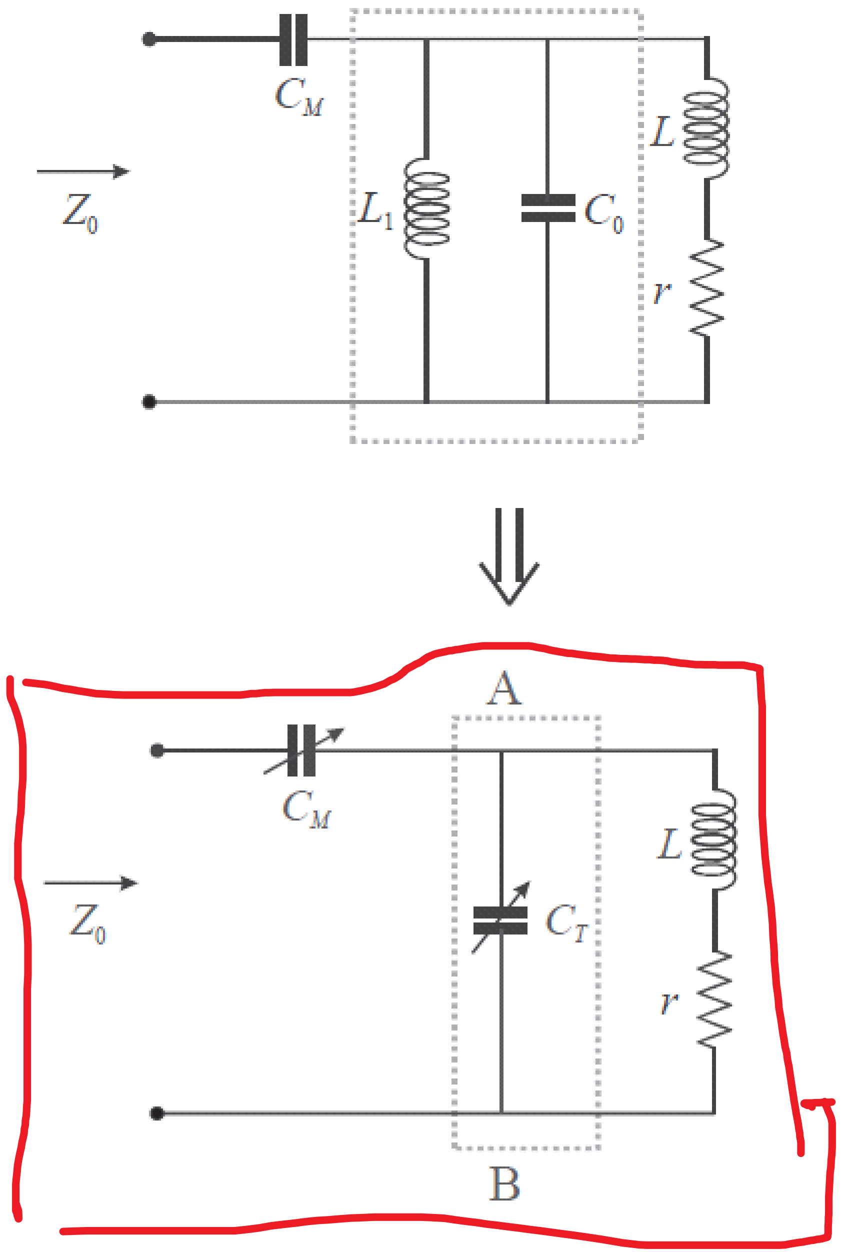
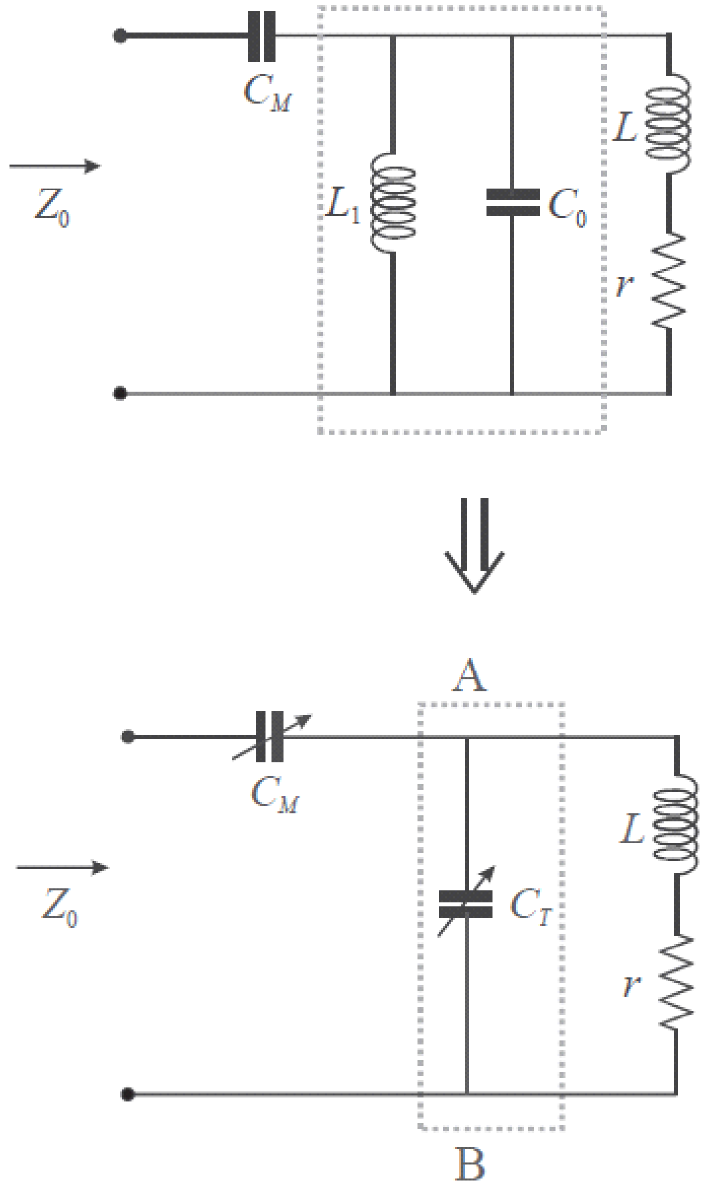


Fig. 4.4 Basic L-networks designed to match resistive loads. (a) $r < Z_0$. (b) $\rho > Z_0$. The input impedance can be either capacitive (left), or inductive (right).





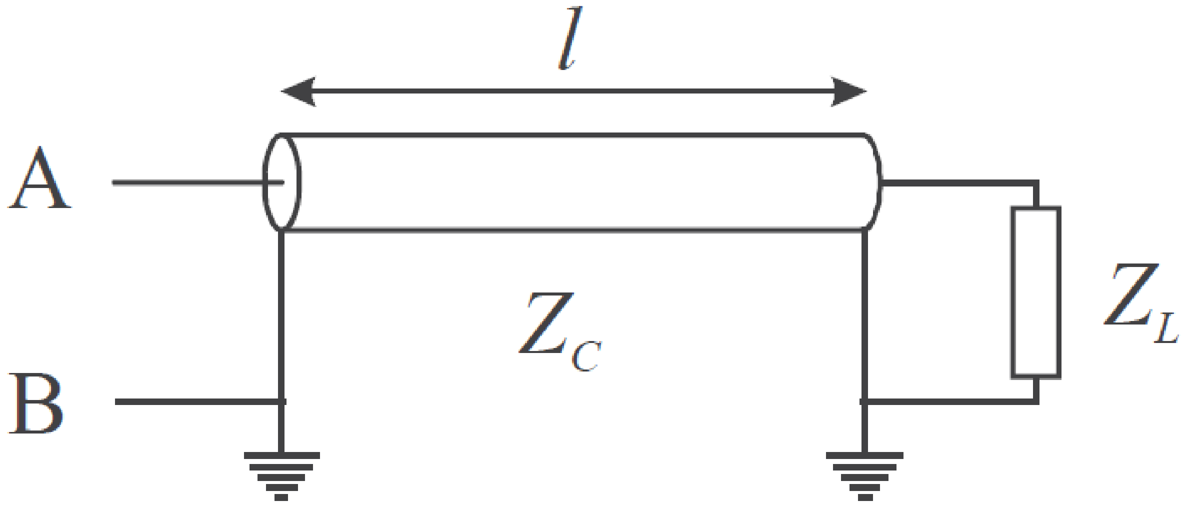
$$Q = \frac{X_L}{R}$$

$$\boxed{Z_0 = \frac{r\,\overbrace{XC_T}^{\frac{1}{\omega C}}{}^{2}}{r^2 + \left(\underbrace{XL}_{\omega L} - XC_T\right)^2}}$$

$$C_M = \frac{1}{\sqrt{(Q\omega L - r)r\omega^2}}$$

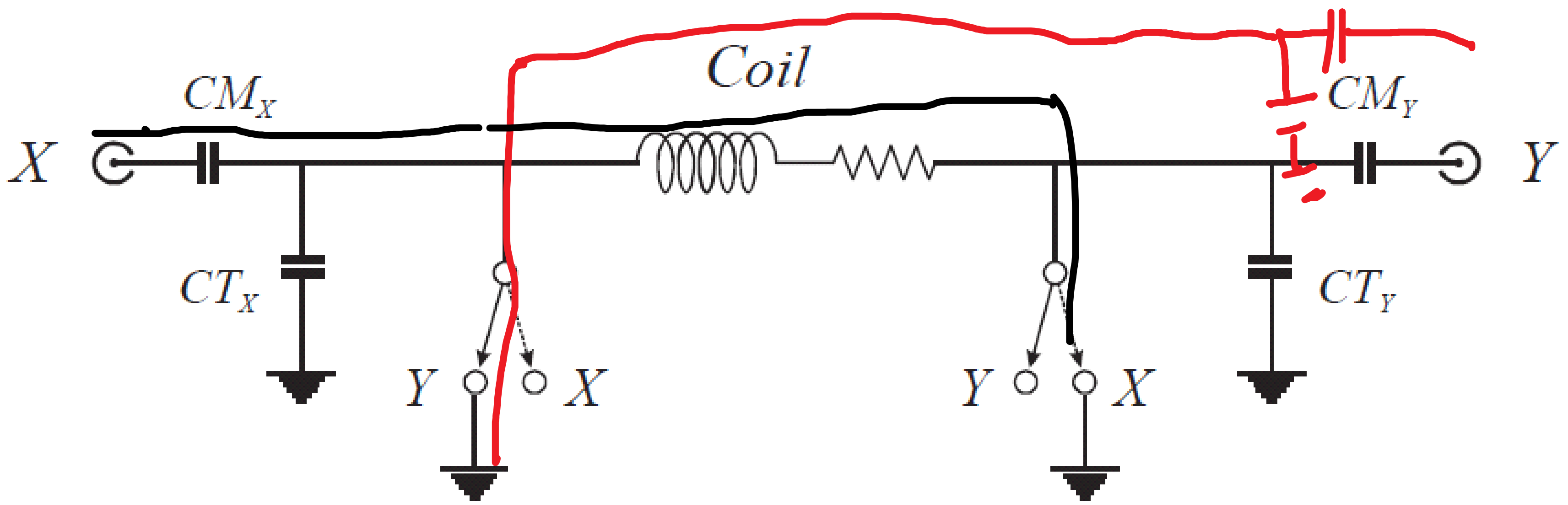
$$C_T = \frac{Qr\omega C_M - 1}{Qr\omega^3 C_M L}$$

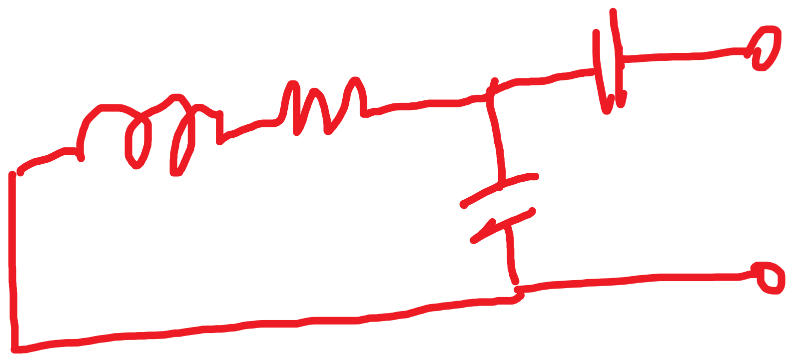
Matching por linha de transmissão



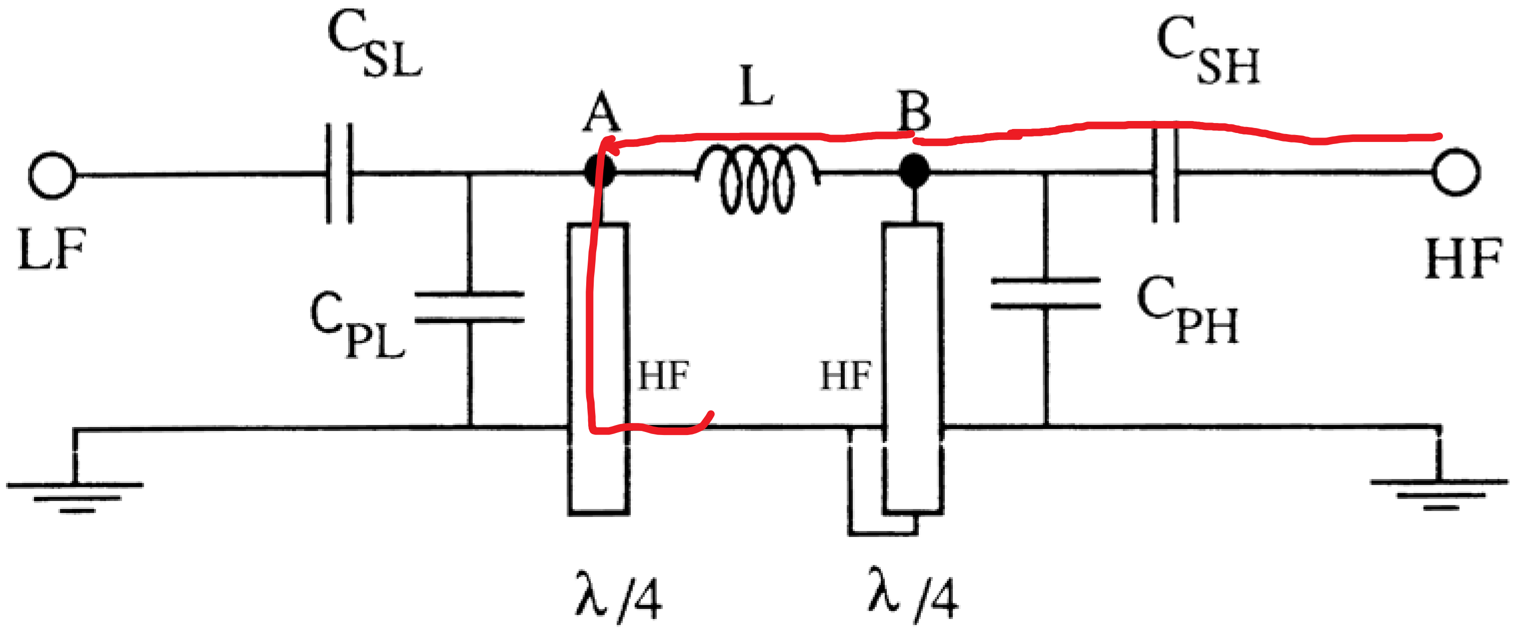
$$\boxed{Z_{AB} = Z_C \frac{Z_L + jZ_C \tan(\theta)}{Z_C + jZ_L \tan(\theta)}}$$

Sonda de dupla ressonância



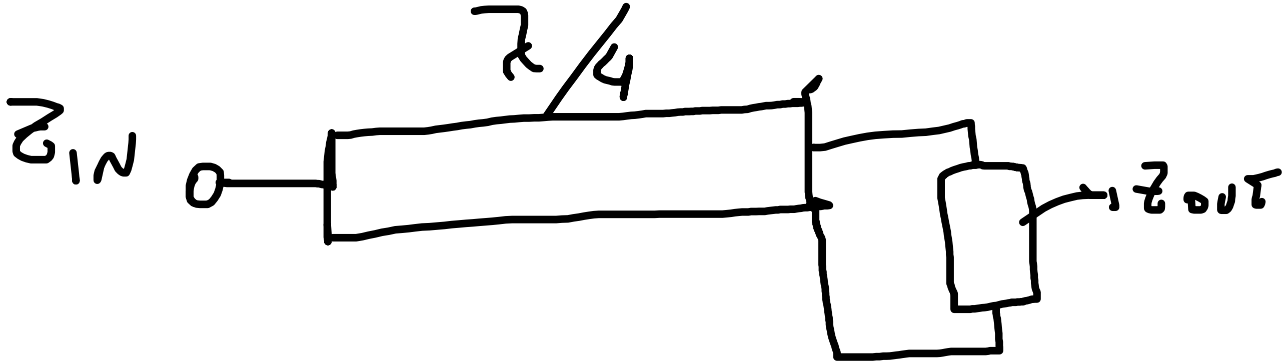


Separação com linhas de transmissão

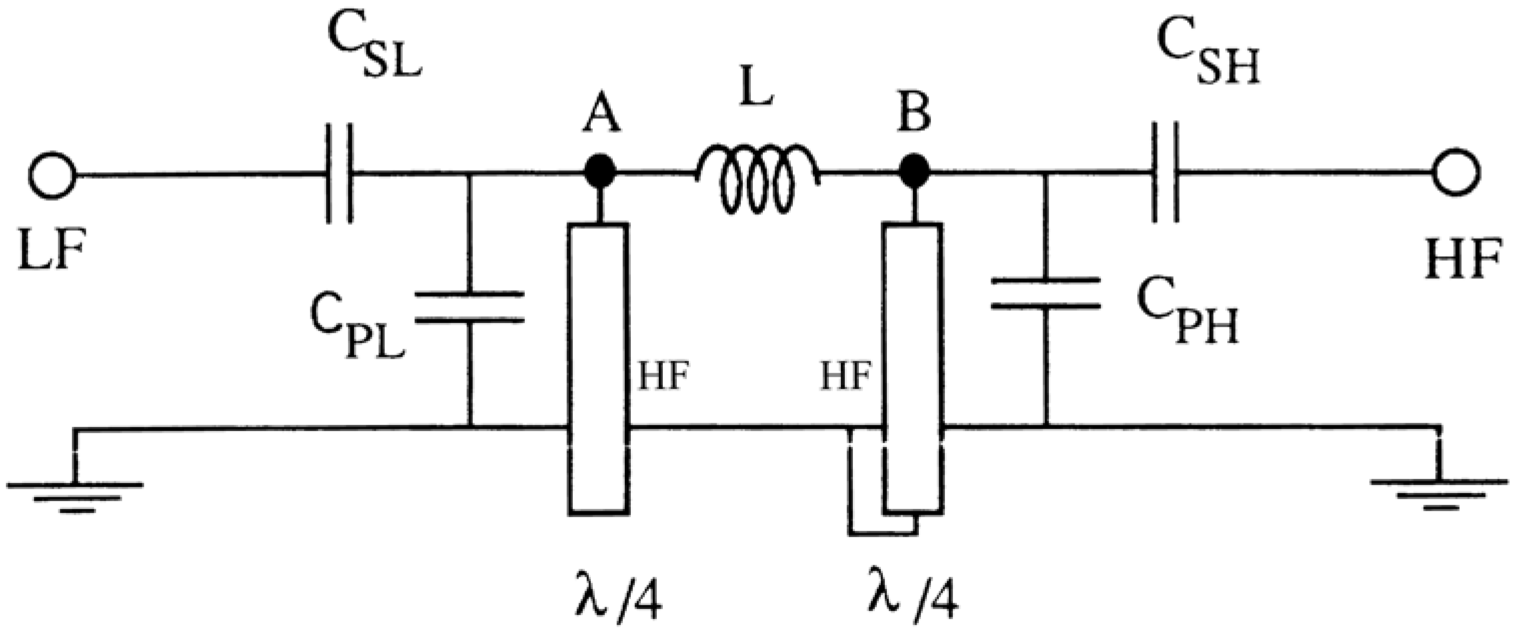


$$Z_{in} = \frac{Z_0^2}{Z_{out}}$$

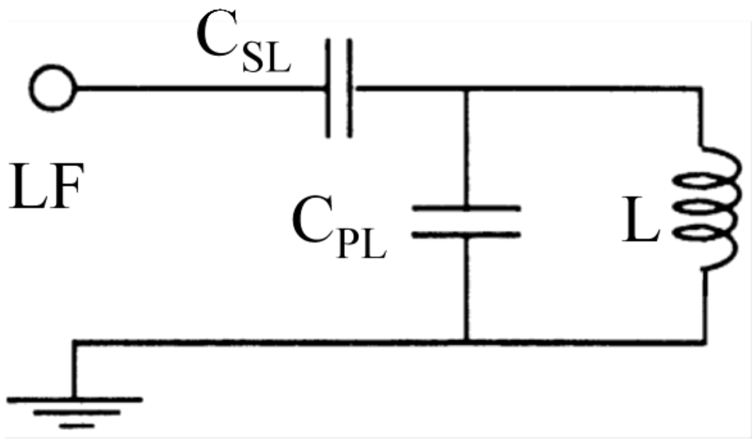
$$Z_{IN} = \frac{Z_0^2}{Z_{OUT}}$$



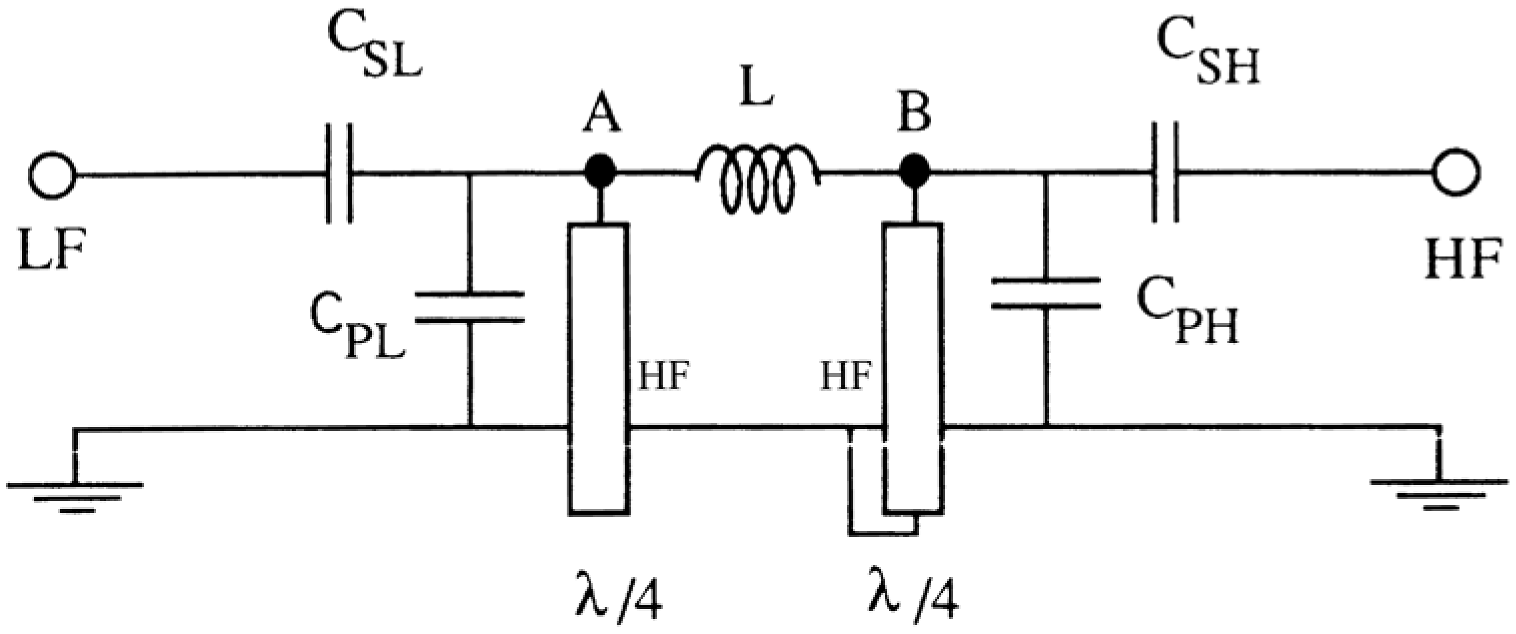
Separação com linhas de transmissão



$$Z_{in} = \frac{Z_0^2}{Z_{out}}$$



Separação com linhas de transmissão



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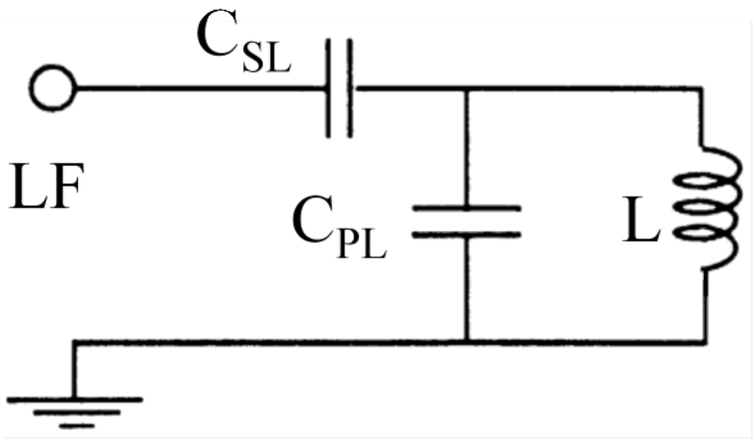
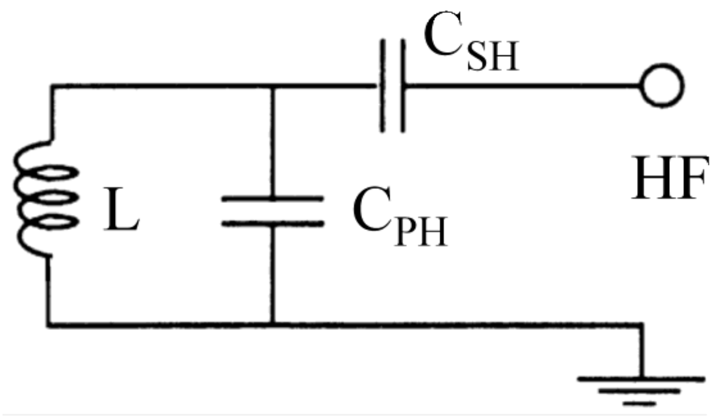
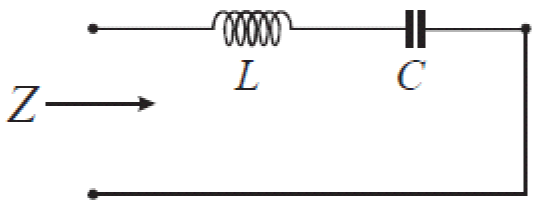
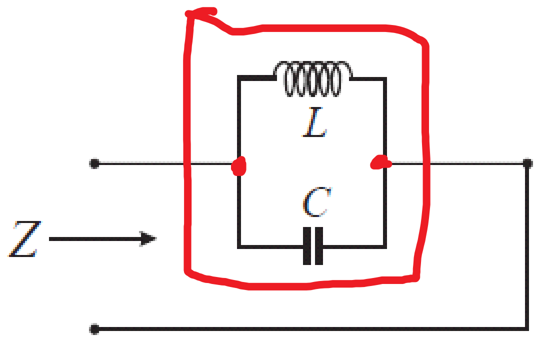
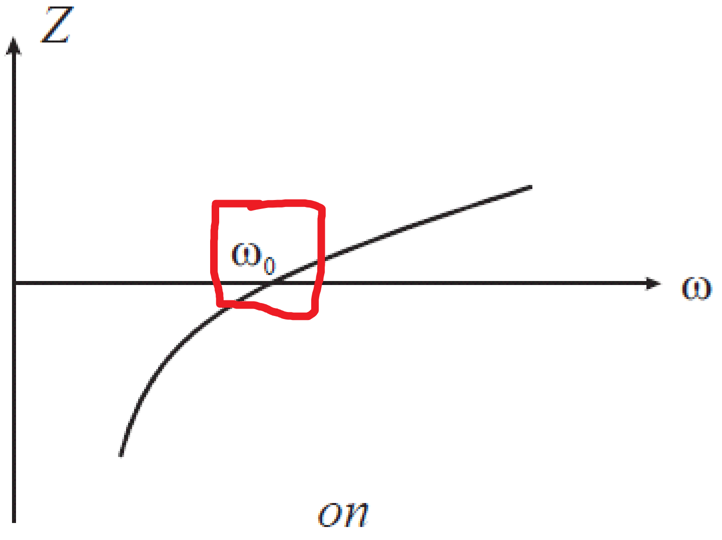


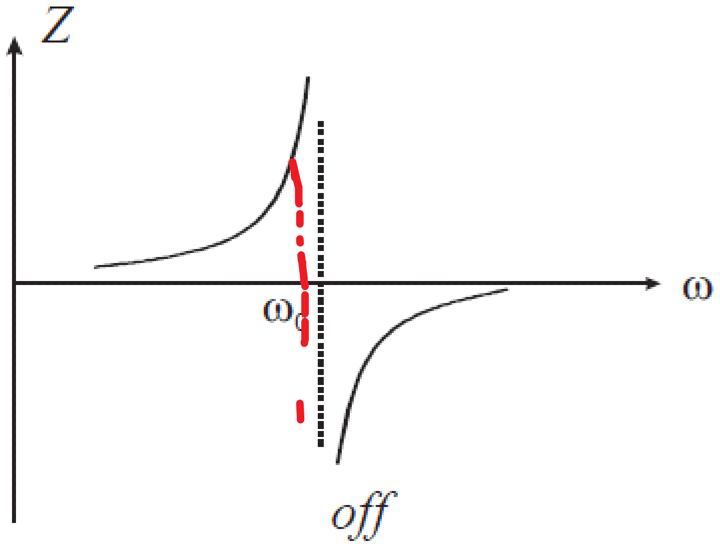


Chaveamento com elementos passivos





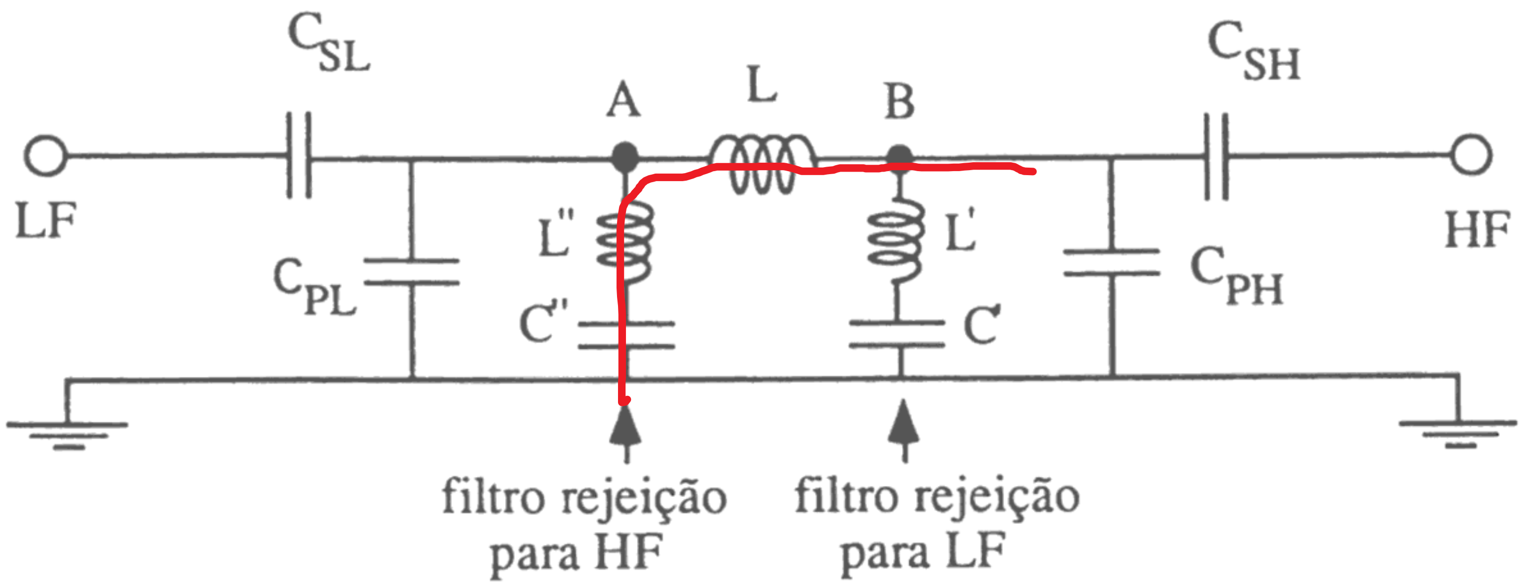


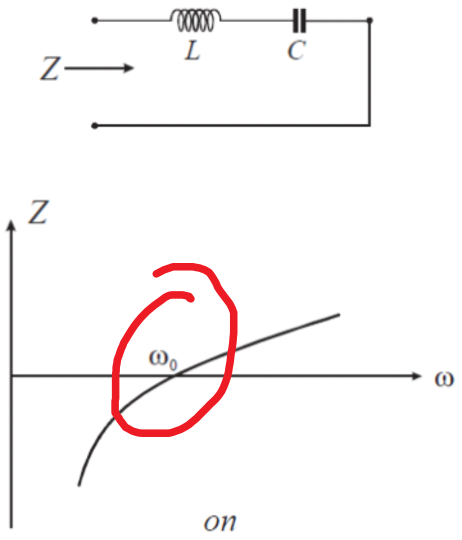


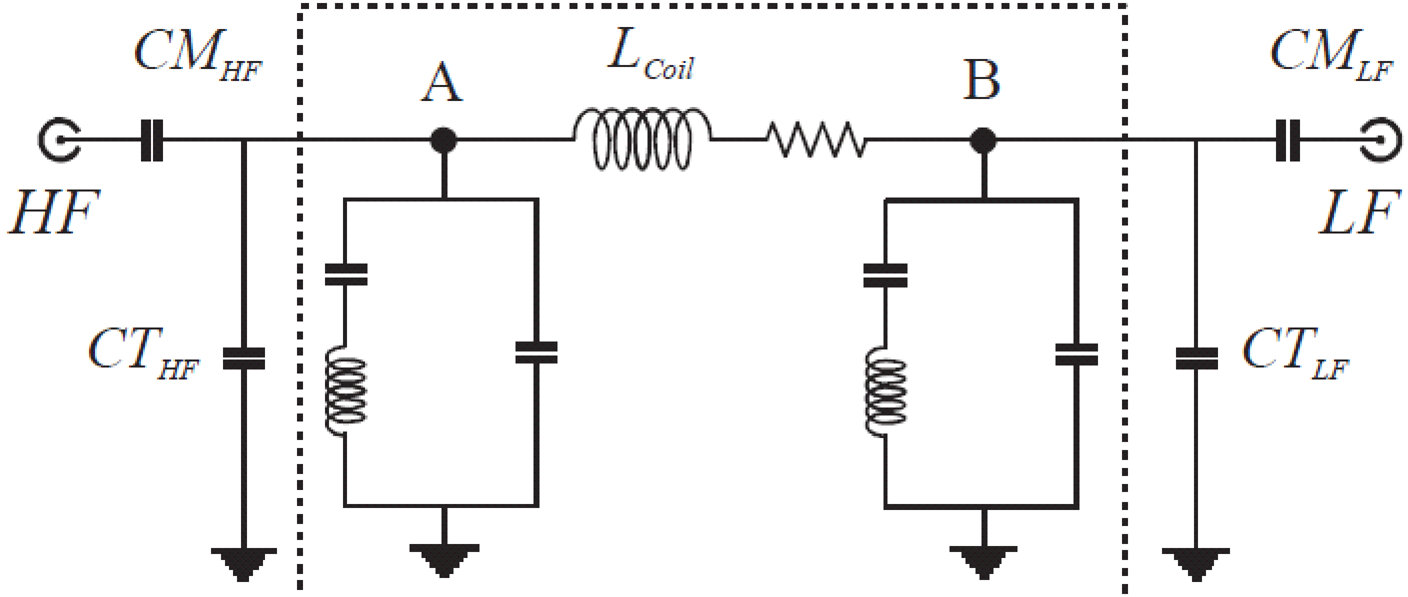
$$Z_{series}(\omega) = \frac{1}{jC\omega}\left(1 - \frac{\omega^2}{\omega_{on}^2}\right)$$

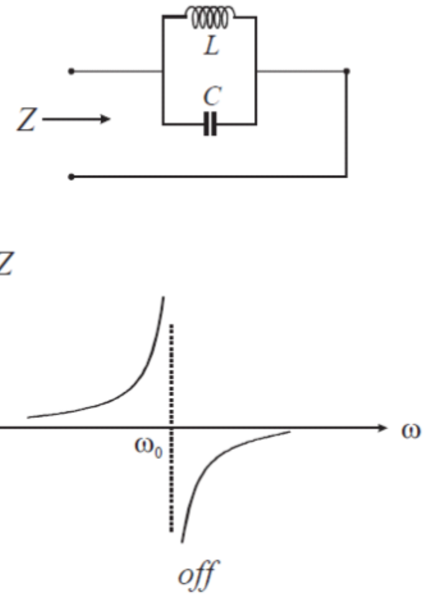
$$Z_{parallel}(\omega) = \frac{1}{jC\omega}\left(1 - \frac{\omega_{off}^2}{\omega^2}\right)^{-1}$$

Utilizando filtros

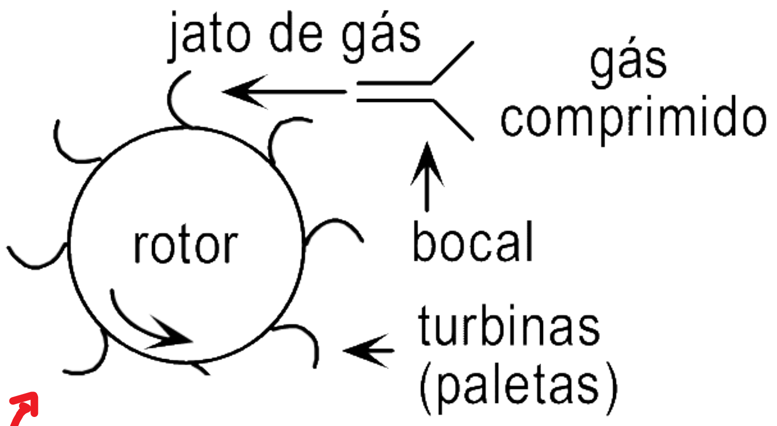


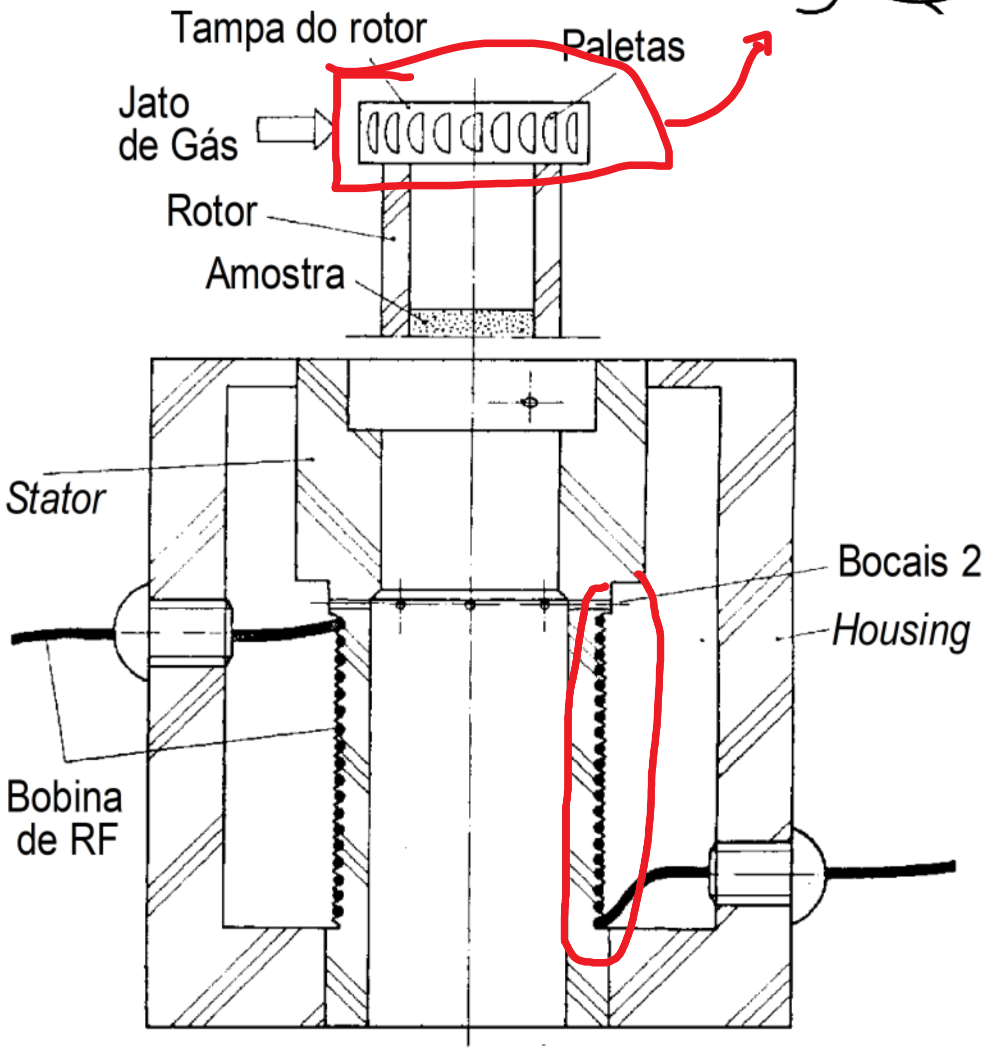


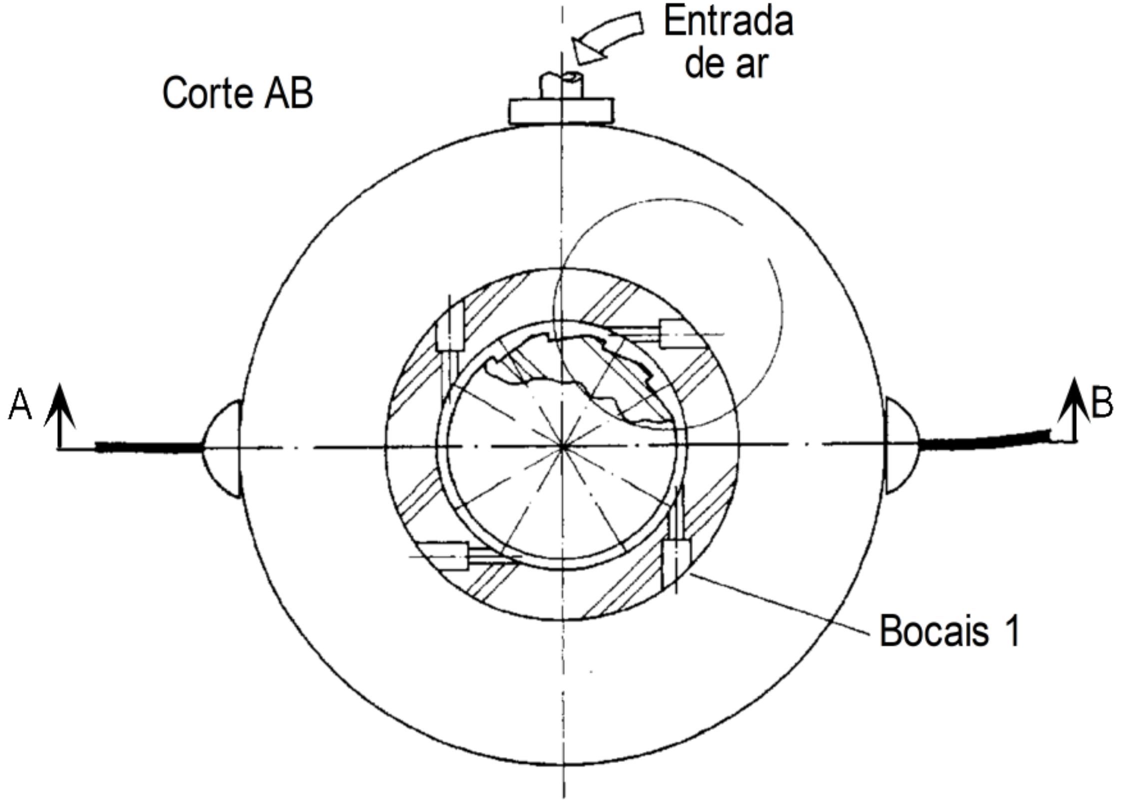


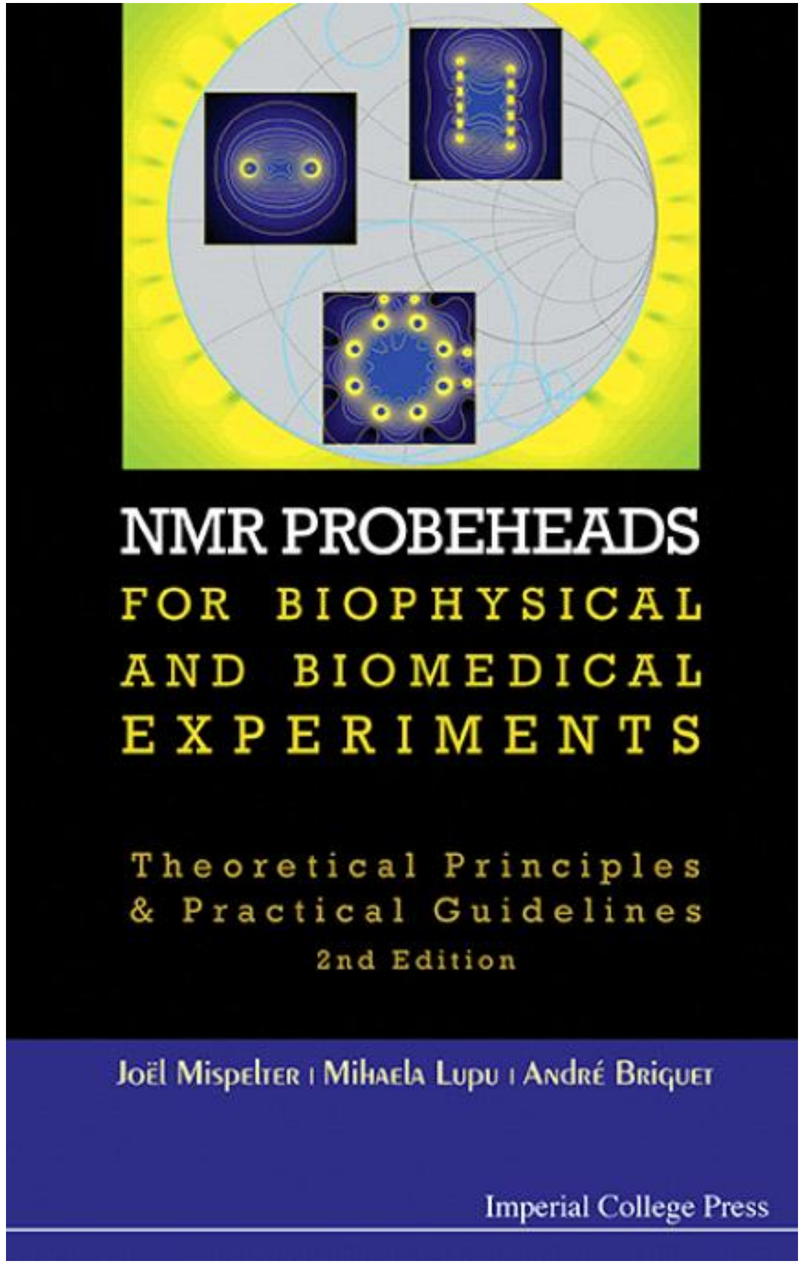


MAS


jato de gás
gás
comprimido
rotor
bocal
turbinas
(paletas)


Tampa do rotor
Paletas
Jato
de Gás
Rotor
Amostra
Stator
Bocais 2
Housing
Bobina
de RF


Entrada
de ar
Corte AB
A
B
Bocais 1



Capítulos 4 e 6