交流电

$V(t) = V_m \cos(\omega t + \varphi)$

$= \mathrm{Re}(V_m e^{j(\omega t+\varphi)})$

$= V_m \angle \varphi$

$= V_m \cos\varphi + j V_m \sin\varphi$

$Z_L = j\omega L$, $Z_C = -j\frac{1}{\omega C}$

$Z = \frac{V}{I}$

遵循全部串并联规律

Power

Avg Power: $P = \frac{1}{2} V_m I_m \cos(\theta_V - \theta_I)$

$= \frac{1}{2}\mathrm{Re}(VI^*)$ (*为共轭)

注意，$P = \frac{1}{2} I_m^2 R = \frac{1}{2}\frac{V_m^2}{R}$ 是错误的

若 $Z = R + jX$，则 $P = \frac{1}{2} I_m^2 R$

$V_{rms} = \frac{V_m}{\sqrt{2}}$ $I_{rms} = \frac{I_m}{\sqrt{2}}$

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Power angle: $\theta = \theta_V - \theta_I = \angle Z$ leading: $\theta_V < \theta_I$

Power factor: $pf = \cos\theta = \frac{P}{|S|}$ lagging: $\theta_V > \theta_I$

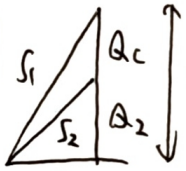
Complex power: $S = \frac{1}{2} VI^* = \frac{1}{2} V_m I_m \angle(\theta_V - \theta_I)$ (单位 VA)

Let $S = P + jQ$

P为平均实际功率 (单位 Watt)

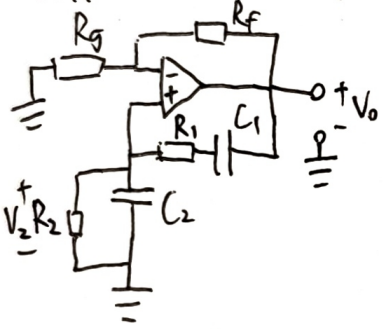
Q为储存在电路中的电量 (单位 VAR)

$Q = \frac{1}{2} I_m^2 X$ ($Z = R + jX$)



$Q_1 = Q_2 + Q_C$ (均为正)

Oscillator：通过直流产生交流电



$\omega_0 = \frac{1}{\sqrt{R_1 R_2 C_1 C_2}}$

$\frac{V_o}{V_2} = 1 + \frac{R_f}{R_g}$

通常 $R_1 = R_2$ $C_1 = C_2$

三相电

$V_a = V_p \angle 0$, $V_b = V_p \angle -120°$, $V_c = V_p \angle -240°$

这是 abc sequence、positive sequence

反过来 acb、negative

4线：Y，3线：△

达到相同功率：$Z_\Delta = 3Z_Y$

4种接线方法：Y-Y，Y-△，△-△，△-Y

$V_L = \sqrt{3} V_p$ (V_L line voltage, e.g. V_{ab}) (Y-Y)

$I_L = \sqrt{3} I_p$ (△-△)

总功率 $P = 3 V_p I_p \cos\theta$ (Y-load)

(V_p、I_p 为 rms，θ 为 Z 的角度)

不准确，应根据实际情况计算

互感

$V=N\frac{d\Phi}{dt}$

下标1,2按常识反过来

$M_{12}=M_{21}=M$

Dot convention：主线圈电流从红点流入，次线圈红点产生正电压

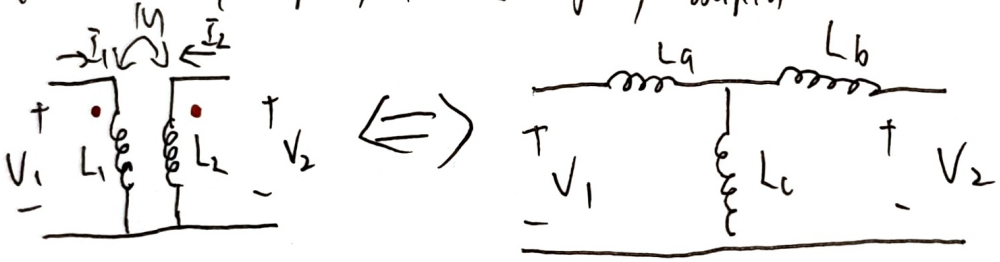
储存能量：$W=\frac{1}{2}L_1I_1^2+\frac{1}{2}L_2I_2^2-MI_1I_2$（要求电流均为正）

（主流入，次流出 dot）

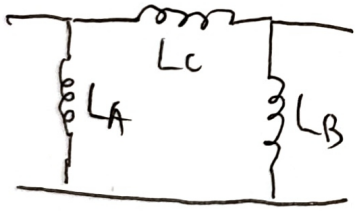
$M\le\sqrt{L_1L_2}$

$k=\frac{M}{\sqrt{L_1L_2}}$ coefficient of coupling

$k<0.5$ loosely coupled, $k>0.5$ tightly coupled



$L_a=L_1-M$ $L_b=L_2-M$ $L_c=M$



$L_A=\frac{L_1L_2-M^2}{L_2-M}$ $L_B=\frac{L_1L_2-M^2}{L_1-M}$

$L_C=\frac{L_1L_2-M^2}{M}$

变压器

$\frac{V_1}{V_2}=\frac{n_1}{n_2}$ $\frac{i_1}{i_2}=\frac{n_2}{n_1}$，$S_1=S_2$

左：右=1：n，右边的Z变为$\frac{1}{n^2}$，V变为$\frac{1}{n}$，I变为n倍

Reflected Impandence

Autotransformers：滑动变阻器