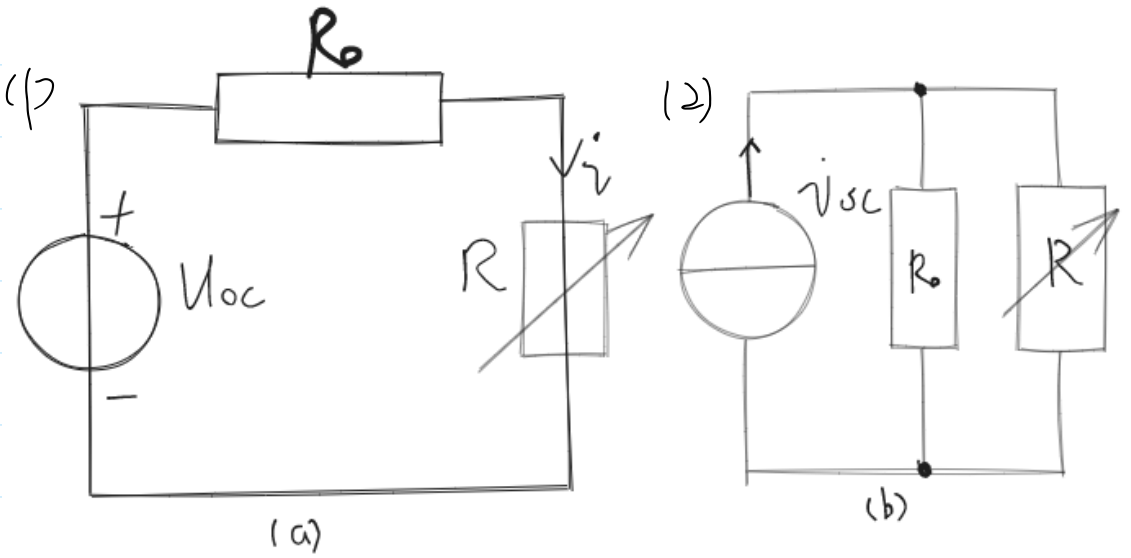
最大功率传输定理推导

Friday, September 8, 2023 5:18 PM



我们设如上电路图：有(1)中，

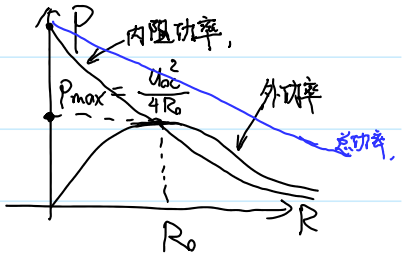
$U=U_{oc}$，则：设外电路阻值可变

则：

$$i=\frac{U_{oc}}{R_0+R},\quad \therefore P_{外}=i^2R=\frac{U_{oc}^2R}{(R_0+R)^2}=U_{oc}^2\left(\frac{1}{R+\frac{R_0^2}{R}+2R_0}\right)$$

由于：$R+\frac{R_0^2}{R}\geq 2R_0$ 则有：$P_{外,max}=\frac{U_{oc}^2}{4R_0}$（在 $R=R_0$ 时，得到）

而内阻功率为：$i^2R_0=\frac{U_{oc}^2R_0}{(R_0+R)^2}$ ⟹



而：对于电流源：有(2)中：

i_{sc}为定值时：$R_{总}=\frac{R_0R}{R_0+R}$，则：$i_1R_0=i_2R\rightarrow i_1+i_2=i$

$\therefore i_2\left(\frac{R}{R_0}+1\right)=i$

i_1R_0

∴有：$i_2=\frac{iR_0}{R_0+R}$

$$\Rightarrow 则P=i^2R=\frac{i^2R_0^2R}{(R_0+R)^2}=\frac{i^2R_0^2}{\frac{R_0^2}{R}+R+2R_0}=\frac{i^2R_0^2}{2R_0+R+\frac{R_0^2}{R}}$$

此时：$\frac{i^2R_0^2}{4R_0}=\frac{i^2R_0}{4}\Rightarrow P_{max}=\frac{1}{4}i_{sc}^2R_0$