Chapter 2

二極體電路

2.1 整流電路

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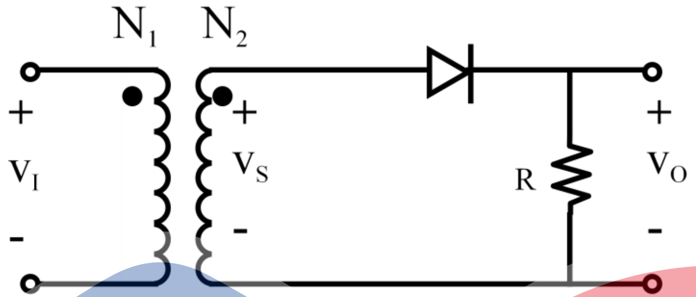
2.1 整流電路

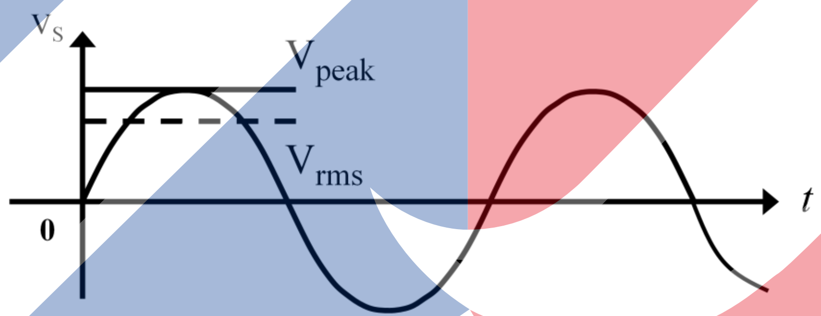
1. 半波整流



$V_I = V_I(rms)$、$V_I(peak)$

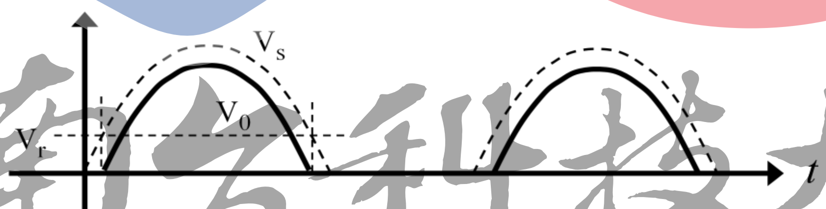
$V_S = V_S(rms)$、$V_S(peak)$

$$\frac{V_I}{V_S} = \frac{N_1}{N_2}$$(變壓器圈數比)



- $V_{rms} = \sqrt{2}V_{peak}$

V_O



$$i_D = \frac{V_S - V_\gamma}{R_L}$$

When $V_S > V_\gamma$，$V_O = V_S - V_\gamma$

When $V_S < V_\gamma$，$V_O = 0$

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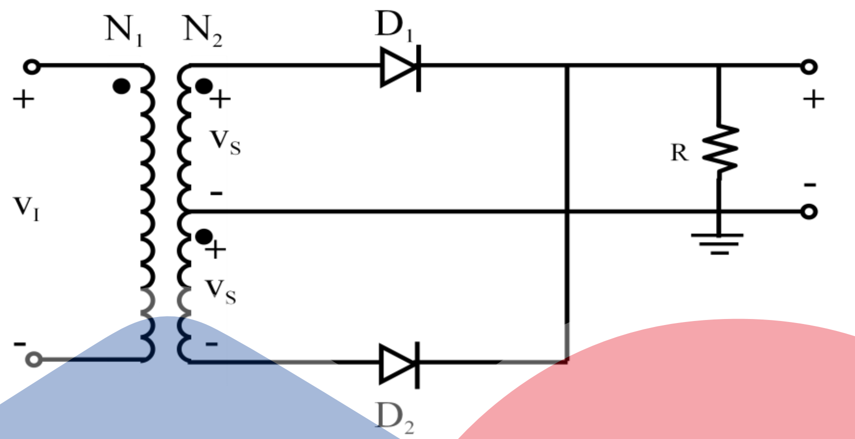
2. 全波整流

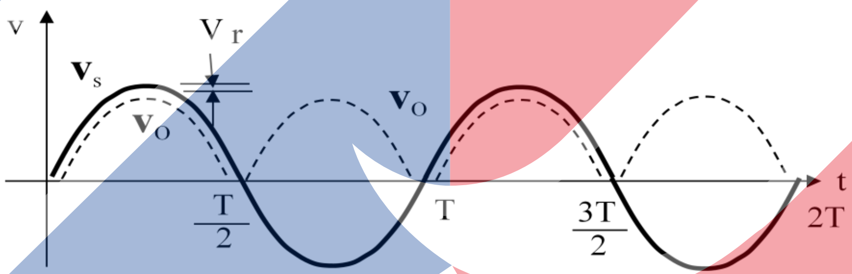


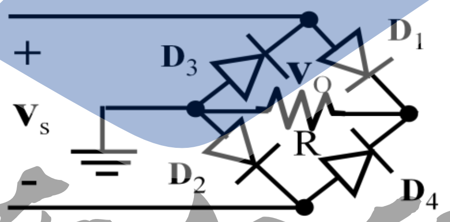
When $V_S > V_\gamma$，$V_{out} = V_S - V_\gamma (D_1 \text{ ON } D_2 \text{ OFF})$

$$V_{o(peak)} = V_M - V_\gamma$$

When $V_S < -V_\gamma$，$V_{out} = -V_S + V_\gamma (D_1 \text{ OFF } D_2 \text{ ON})$

$$V_{o(peak)} = -(-V_M) - V_\gamma = V_M - V_\gamma$$





When $V_I > 2V_\gamma$，D_1D_2ON、D_3D_4OFF

$$V_O = V_S - 2V_\gamma$$

When $V_I < -2V_\gamma$，D_3D_4ON、D_1D_2OFF

$$V_O = V_S - 2V_\gamma$$

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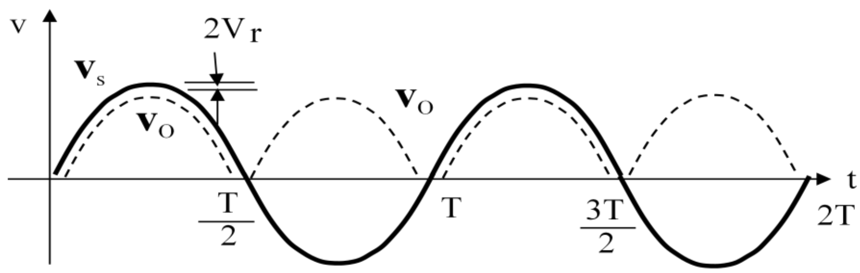
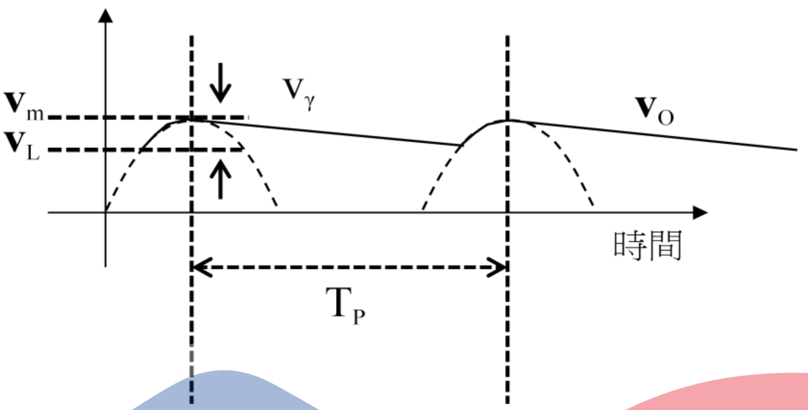
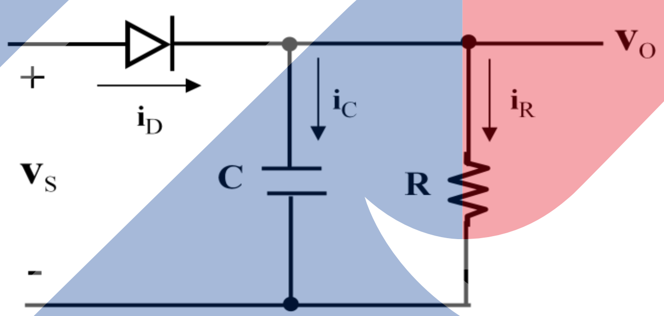




$V_L = V_m e^{-\frac{T}{RC}}$，T 為 RC 放電時間

鏈波電壓(Ripple Voltage)

$V_{ripple} = V_m - V_L = V_m - V_m e^{-\frac{T}{RC}} = V_m(1 - e^{-\frac{T}{RC}})$



假設 T<<RC

$e^{-\frac{T}{RC}} \cong 1 - \frac{T}{RC}$代入上式

$V_{ripple} = V_m\left(1 - \left(1 - \frac{T}{RC}\right)\right) \cong V_m\left(\frac{T}{RC}\right) \cong V_m\left(\frac{T_P}{RC}\right) = V_m\frac{1}{RCf}$(半波)

$V_{ripple} = V_m\left(\frac{T_P}{2RC}\right) = V_m\frac{1}{2RCf}$(全波)

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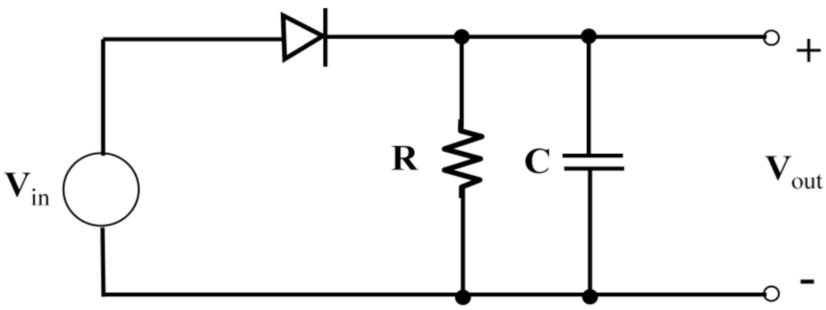

充電:

$i_D = i_C + i_R = C\frac{dV_O}{dt} + \frac{V_O}{R}$ {$t = 0^-$附近、$V_o \cong V_m \cos\omega(-\Delta t) = V_m \cos\omega(\Delta t)$

$\because \Delta t \to 0$

$\Rightarrow \omega\Delta t \to 0 = 1 - \frac{1}{2}(\omega\Delta t)^2$

$$V_O = V_m \cos\omega(\Delta t) = V_m\left[1 - \frac{1}{2}(\omega\Delta t)^2\right] = V_m - V_{ripple}$$

$$V_m - V_m\left[\frac{1}{2}(\omega\Delta t)^2\right]$$

$$V_{ripple} = V_m\left[\frac{1}{2}(\omega\Delta t)^2\right]$$

$$(\omega\Delta t)^2 = \frac{2V_{ripple}}{V_m}$$

$$\omega\Delta t = \sqrt{\frac{2V_{ripple}}{V_m}}$$

求$i_{D(max)}$

$$i_{D(max)} = i_{C(max)} + \frac{V_m}{R}$$

$$i_{C(max)} = C\frac{dV_O}{dt}(t = -\Delta t)$$

$$= C\frac{dV_m \cos\omega(t)}{dt}(t = -\Delta t)$$

$$= -CV_m\omega \sin\omega(\Delta t)$$

$$= CV_m\omega(\omega\Delta t)$$

$$= CV_m\omega\sqrt{\frac{2V_{ripple}}{V_m}}$$

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$$= CV_m \frac{V_m \pi}{V_{ripple} RC} \sqrt{\frac{2V_{ripple}}{V_m}} = 2\pi \frac{V_m}{R} \sqrt{\frac{V_m}{2V_{ripple}}}$$

$$i_{D(avg)} = i_{C(avg)} + \frac{V_m}{R}$$

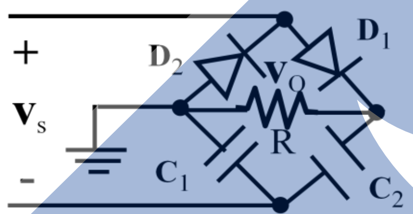
$$= \frac{CV_{ripple}}{\Delta t} + \frac{V_m}{R}$$

$$= \frac{CV_{ripple}}{\frac{RCV_{ripple}}{\pi V_m}} \sqrt{\frac{V_m}{2V_{ripple}}} + \frac{V_m}{R}$$

$$= \frac{\pi}{R} V_m \sqrt{\frac{V_m}{2V_{ripple}}} + \frac{V_m}{R}$$

$$= \frac{V_m}{R}\left(1 + \pi \sqrt{\frac{V_m}{2V_{ripple}}}\right)$$ =>$2i_{D(avg)}$=$i_{D(max)}$

- 倍壓電路(Voltage Doubler Circuit)



When $V_S < V_\gamma$時

$D_1 \rightarrow$ OFF

$D_2 \rightarrow$ ON

電容C_1充電至$V_S - V_\gamma$

峰值此時$V_{C1,2} = V_\gamma - V_O$

When $V_S > V_\gamma$時

$D_1 \rightarrow$ ON

$D_2 \rightarrow$ OFF

因此時電容C_1電壓為$V_{C1,2}$=$V_S - V_\gamma$

同時對C_2充電

則$V_O = V_S - V_\gamma + V_S - V_\gamma = 2V_S - 2V_\gamma \cong 2V_m$

第三半周時 電容不在充電

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