
廣東工業大學
Guangdong University of Technology
广东工业大学
7.3 间接调频
信息工程学院
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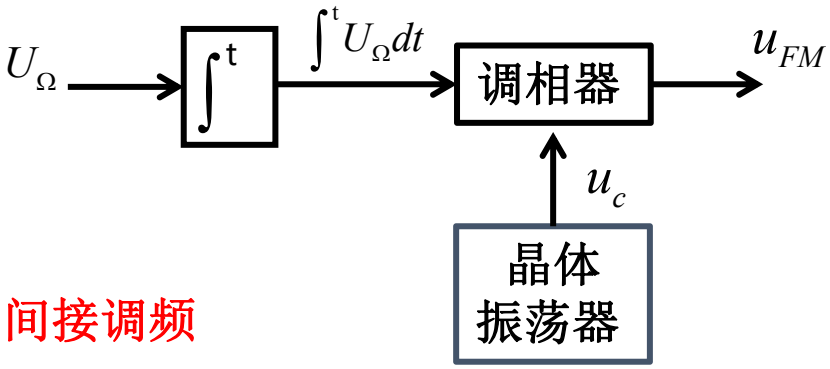
# 7.3 变容二极管特性

## 一、间接调频

$$\triangle\varphi(t) = k_p \int kU_\Omega(t)$$

$$\varphi(t) = \omega_c t + \triangle\varphi(t)$$

$$\omega(t) = \omega_c + k_p k U_\Omega(t)$$

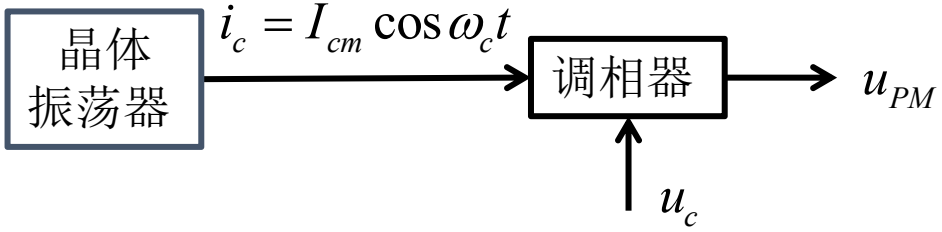



间接调频

# 7.3 变容二极管特性

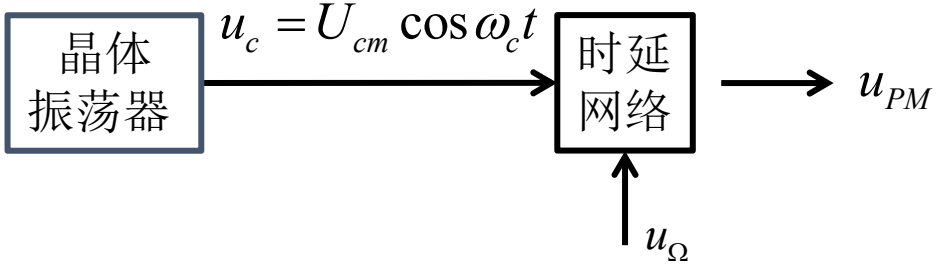
## 一、间接调频

### 1. 相移法




窄带调相：$m_p = k_p u_\Omega < \dfrac{\pi}{6}$

### 2. 时延法




窄带调相：$m_p = k_p u_{\Omega m} < \pi$

# 7.3 变容二极管特性

## 一、间接调频

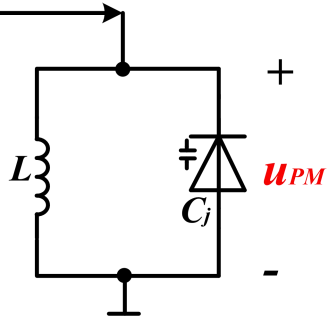
### 3. 变容二极管调相

$$\omega_0 = \frac{1}{\sqrt{LC_j}}$$

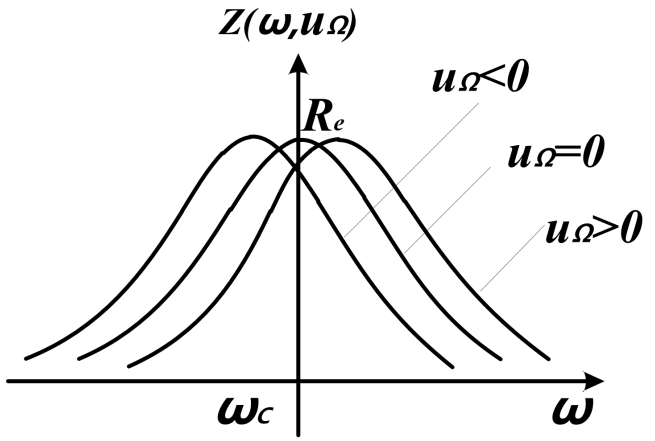
$u_\Omega = 0$ 时 $\omega_0 = \omega_c$　　$\omega_c = \dfrac{1}{\sqrt{LC_{jQ}}}$

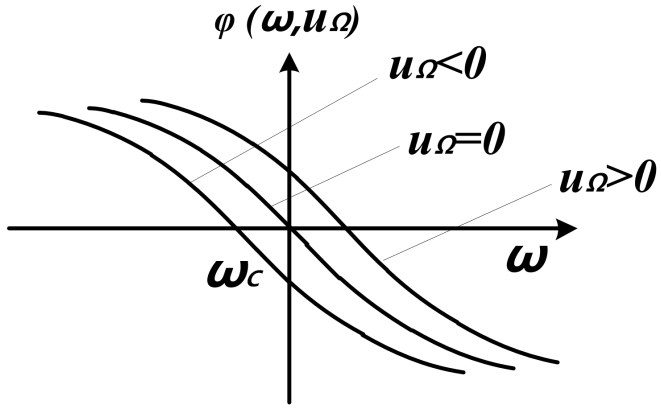
晶体振荡器

$i_c = I_{cm}\cos\omega_c t$




用作相移网络的变容二极管*LC* 并联谐振回路

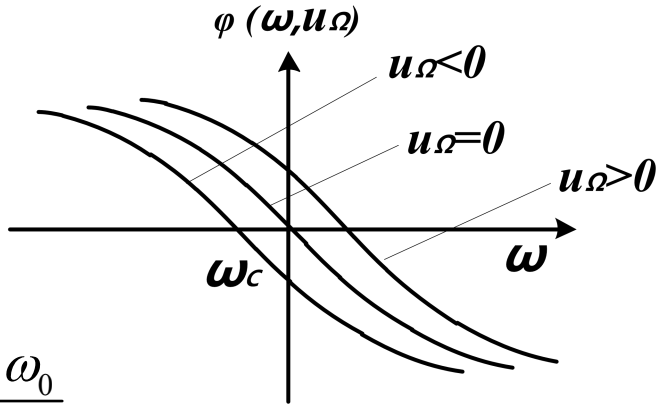



*LC*并联谐振回路幅频特性和相频特性

# 7.3 变容二极管特性

## 一、间接调频




$$\varphi(\omega_c,u_\Omega)=-\tan^{-1}2Q_e\frac{\omega_c-\omega_0}{\omega_0}$$

$x\ll 1 \qquad \tan^{-1}x\approx x$

$$\Delta\omega<<\omega_c \qquad \varphi(\omega_c,u_\Omega)=-2Q_e\frac{\omega_c-\omega_0}{\omega_0}\approx -2Q_e\frac{\omega_c-\omega_0}{\omega_c}$$

变容指数n=2，或n≠2且结电容调制度m<<1时

$$\omega_0\approx\omega_c+\omega_c\frac{n}{2}m\cos\Omega t \qquad \varphi(\omega_c,u_\Omega)=Q_e nm\cos\Omega t$$

$u_{PM}$ 的相位：$\varphi(t)=\omega_c t+\varphi(\omega_c,u_\Omega)=\omega_c t+Q_e nm\cos\Omega t$

$$u_{PM}=I_{cm}R_e\cos(\omega_c t+Q_e nm\cos\Omega t)$$

$u_\Omega$积分后加到变容二极管→变容二极管间接调频

$$\omega(t)=\frac{d\varphi(t)}{dt}=\omega_c-Q_e nm\Omega\sin\Omega t \qquad \triangle\omega_m=Q_e nm\Omega \qquad m_f=\frac{\triangle\omega_m}{\Omega}=Q_e nm$$

# 谢谢！