

高频混合 π 晶体管截止频率计算

不同的集电极电流[共射结构, +15v VCC; 2N3904]

公式	例 1-1 mA 偏置	例 1-2 mA 偏置
$g_m = 40 I_C $	$40 \times 1\text{mA} = 40\text{mmho}$	$40 \times 10\text{mA} = 400\text{mmho}$
由特性表 $\beta_O = h_{fe}$	大约 120 @ 1mA	大约 160 @ 10 mA
$r_\pi = \beta_O \div g_m$	$120 / 40 \times 10^{-3} = 3000\Omega$	$160 / 0.4 = 400\Omega$
r_x	估计 $\approx 25\Omega$	估计 $\approx 25\Omega$
LF 增益 $A_v = -g_m R_L$	$-300[R_L = 7.5\text{k}]$	$-300[R_L = 750\Omega]$
$C_\mu = C_{ab}$ [由特性单]	Vcb = -7.0V时, 1.8pF	Vcb = -7.0V时, 1.8pF
由特性单 f_T	300MHz	300MHz
$C_\pi = \frac{g_m}{2\pi f_T} - C_\mu$	$= 21.2\text{pF} - 1.8\text{pF} \approx 20\text{pF}$	212pF
$C_T = C_\pi + (g_m R_L + 1)C_\mu$ $\approx 150\text{MHz!}$	$= 20\text{pF} + 301 \times 1.8\text{pF} = 562\text{pF}$	$= 212\text{pF} + 301 \times 1.8\text{pF} = 754\text{pF}$
$\frac{v_\pi}{v_s} = \frac{1}{\frac{R'_S}{r_\pi} + 1 + j\omega R'_S C_T}$ [公式取自 HF 截至页, $R'_S = R_S + r_x$]	$= \frac{1}{\frac{75}{3000} + 1 + j\omega 75 \times 562\text{pF}}$ $f_{3\text{dB}} = 3.8\text{MHz}$	$= \frac{1}{\frac{75}{400} + 1 + j\omega 75 \times 754\text{pF}}$ $f_{3\text{dB}} = 3.3\text{MHz}$
如果我们将输入电阻与 51 Ω 的电阻并联 ($r_\pi + r_x // C_T$)	$= \frac{1}{\frac{51}{51} + 1 + j\omega 75 \times 562\text{pF}}$ $f_{3\text{dB}} = 7.6\text{MHz}$	$= \frac{1}{\frac{51}{45} + 1 + j\omega 75 \times 754\text{pF}}$ $f_{3\text{dB}} = 5.9\text{MHz}$