



## ⑦

1. 正弦波振荡的平衡条件:  $A_f = 1 \Rightarrow |A_f| = 1, \varphi_A + \varphi_F = 2\pi f$ .

2. 正弦波振荡电路组成: (1) 选频网络 (使幅值增益自动动态平衡). (2) 节拍网络.

(3) 反馈网络 (使放大电路所反馈输入信号等于反馈信号). (4) 稳幅环节 (非线性环节).

判断题: (1) 是否包含四个组成部分. (2) 放大电路能否正常工作 (静态工作点). (3) 用时极性法, 断开反馈, 判断极性是否是正反馈. (4)  $A_f$  是否大于 1, 驱振条件.

3. RC 正弦波振荡电路: (1) RC 并联选频网络:  $f_0 = \frac{1}{2\pi RC}$ , 当  $f = f_0$  时,  $\frac{T}{f} = \frac{1}{3}, |A_f| = \frac{1}{3}|U_o|, \varphi = 0^\circ$ . (2) 与之匹配的节拍网络常满足:  $U_o = U_i$  同相.

$A_u = 3$ , 因此应有大输入电阻和小输出电阻, 如电压串联负反馈放大电路  $R_F$ .

(1)  $P_1$   $\rightarrow$  以 RC 并联选频网络作为节拍网络和正反馈网络:  $D_F > 1$ .

$R_F$  为正温度系数对热敏电阻 /  $D_F$  为负温度系数: 非线性特性不改.

(2)  $L_C$  正弦波振荡电路: (1)  $L_C$  谐振振回路:  $f_0 = \frac{1}{2\pi \sqrt{LC}}$ ,  $Q = \frac{1}{R_L}$ .

(3) 变压器反馈式: 注意确定同名端电源, 相当于搭地看哪一级极性圈形.

输出量为正反馈量, 注意通常正反馈支路上带有电容 (隔直), 否则失真.

歪斜态工作点, 万次网路不工点. (4) 电感反馈式 (三点式) 共基极振荡法和共.

振法, 正反馈支路极性要看反馈量从哪一路输出. 电容三点式同理.

4.  $A_{usm} = A_{usm} \cdot \frac{(1 + \frac{f_e}{f_H})(1 + \frac{f_L}{f_H})}{(1 + \frac{f_e}{f_H})(1 + \frac{f_L}{f_H}) - 1}$ ,  $f = \frac{1}{2\pi R_C}$ ,  $|A_{usm}|_{fbw} = \frac{1}{2\pi(R_{bb} + R_S)C_H}$ .

5.  $A_{usm}$  大) 倍中频直通:  $80 \rightarrow 10^4$  60  $\rightarrow 10^3$ . 低频段摆点, 代表阻容耦合.

斜率表示 12dB/10 倍带宽以及摆点对应频率  $f_L, f_H$ . ( $A_{usm}$  是有负号)

$f_H = f_H / 1.1T_n$ ,  $f_L = 1.1T_n f_L$ .

② 反馈 (中频段)

1.  $X_i + X_o \rightarrow A = \frac{X_o}{X_i}, A_f = \frac{X_o}{X_i}, f = \frac{X_o}{X_i}$  (反馈系数)

环路放大倍数  $A_f = \frac{X_o}{X_i}$ .

$\Rightarrow A_f = \frac{A}{1 + A_f}$ , 深度负反馈:  $A_f \approx \frac{1}{A}$ ,  $A_f > 0$ , 正反馈:  $A_f < 0$ .

深度负反馈:  $X_i = X_f$  (输入量等于反馈量) 并联反馈:  $I_f = I_o$ , 并联反馈  $U_i = U_f$

2. (1)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = -R$ .

$R_s$  为信号源内阻,  $R_s$  全部降落在  $R_s$  上.

(2)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = -R$  (信号源内阻不可忽略).

(3)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = \frac{U_o}{U_{co}} = \frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = R$ .

(4)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = -R$  (由串并联).

(5)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = -R$  (由串并联).

(6)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = -R$  (由串并联).

(7)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(8)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(9)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(10)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(11)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(12)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(13)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(14)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(15)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(16)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(17)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(18)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(19)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(20)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(21)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(22)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(23)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(24)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(25)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(26)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(27)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(28)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(29)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(30)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(31)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(32)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(33)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(34)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(35)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(36)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(37)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(38)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(39)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(40)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(41)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(42)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(43)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(44)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(45)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(46)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(47)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(48)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(49)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(50)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(51)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(52)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(53)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(54)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(55)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(56)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(57)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(58)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(59)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(60)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(61)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(62)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(63)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(64)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(65)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(66)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(67)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(68)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(69)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(70)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(71)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(72)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .

(73)  $\Rightarrow F_{iu} = \frac{U_o}{U_i} = -\frac{U_o}{U_{co}} = -\frac{1}{R_s} = A_{iuf} = \frac{I_{uo}}{I_i} \approx \frac{U_o}{U_f} = \frac{1}{f_{iu}} = \frac{1}{R_s}$ .