Chapter 9. 理想操作放大器及其電路

9.7 操作放大器電路設計

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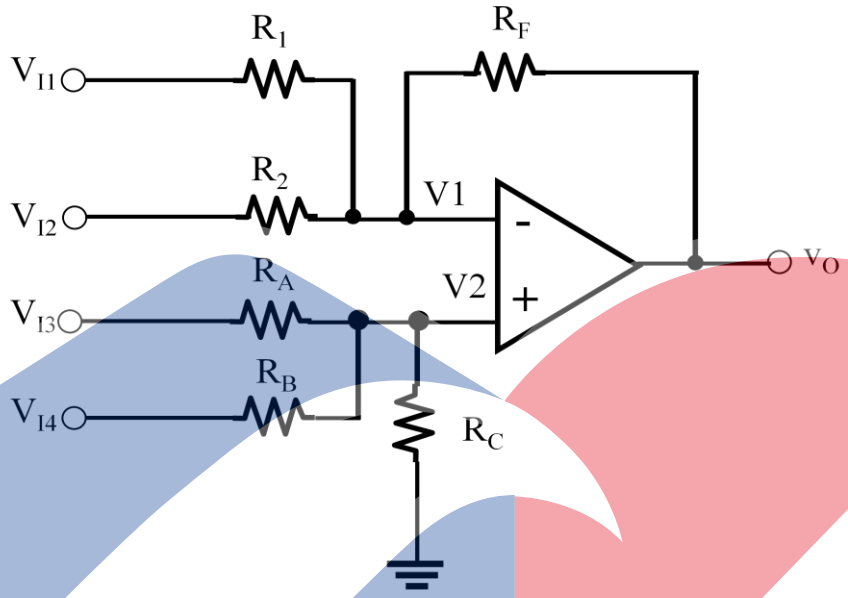
1. 加法器



A. 考量v_{I1}，$v_{I2} = v_{I3} = v_{I4} = 0$

$$v_{O1} = -R_F \frac{v_{I1}}{R_1}$$

B. 考量v_{I2}，$v_{I1} = v_{I3} = v_{I4} = 0$

$$v_{O2} = -R_F \frac{v_{I2}}{R_2}$$

C. 考量v_{I3}，$v_{I1} = v_{I2} = v_{I4} = 0$

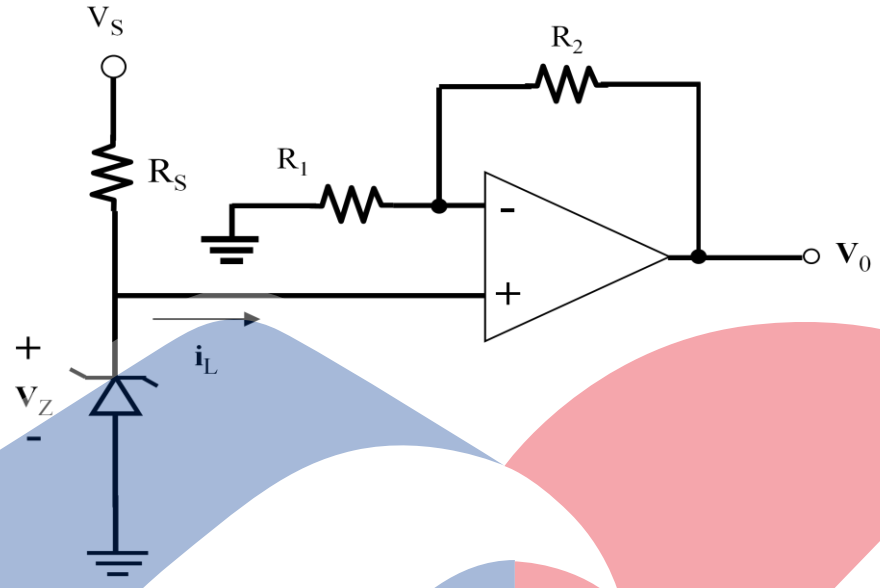
$$v_{O3} = \frac{R_B \parallel R_C}{R_A + R_B \parallel R_C}\left(1 + \frac{R_F}{R_1 \parallel R_2}\right)v_{I3}$$

D. 考量v_{I4}，$v_{I1} = v_{I2} = v_{I3} = 0$

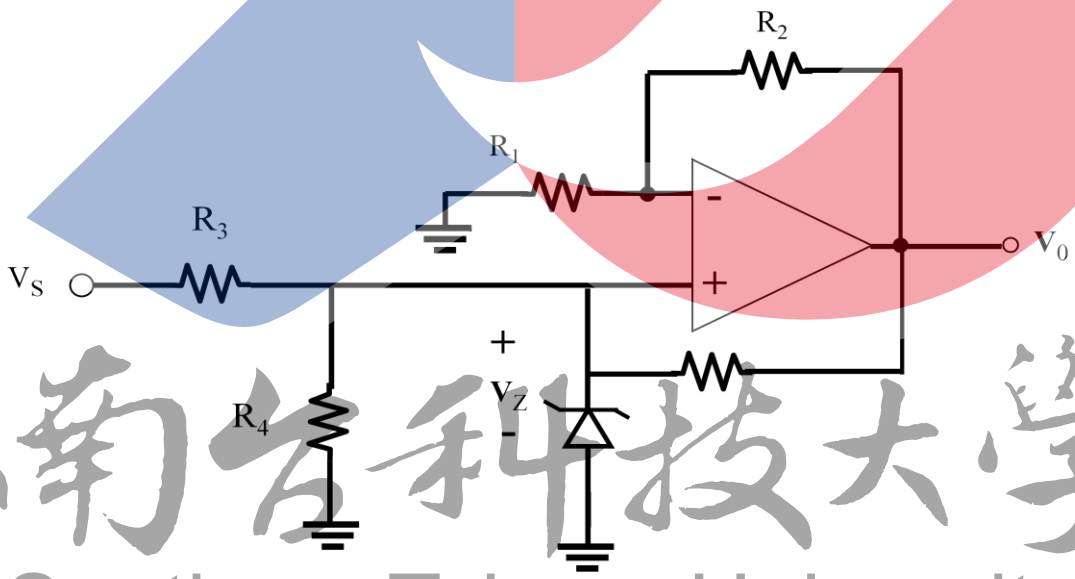
$$v_{O4} = \frac{R_A \parallel R_C}{R_B + R_A \parallel R_C}\left(1 + \frac{R_F}{R_1 \parallel R_2}\right)v_{I4}$$

E. $v_O = v_{O1} + v_{O2} + v_{O3} + v_{O4}$

2. 參考電壓源設計



$$v_o = (1 + \frac{R_2}{R_1})v_Z$$



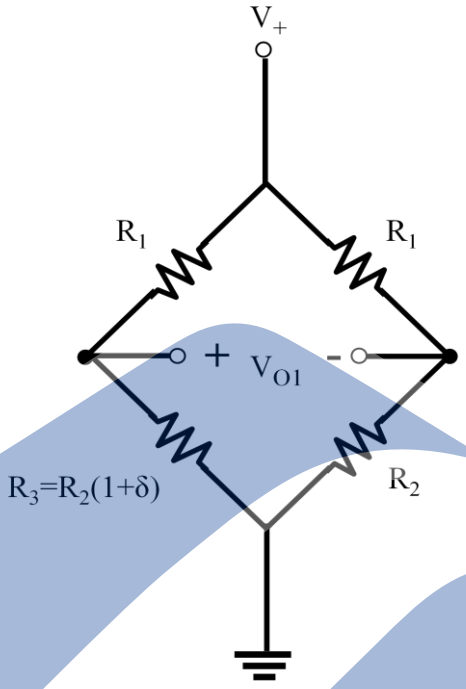
$$v_o = (1 + \frac{R_2}{R_1})v_Z$$

When $v_S \frac{R_4}{R_4 + R_3} > v_Z + v_D \cong v_Z + 0.7V$

使v_Z導通

$$i_F = \frac{v_o - v_Z}{R_F} = \frac{\frac{R_2}{R_1}v_Z}{R_F} = \frac{R_2 v_Z}{R_1 R_F} > i_Z(\min)$$

3. 差值放大器及橋式電路設計



$$v_{o1} = \frac{R_2(1+\delta)}{R_2(1+\delta)+R}V^+ - \frac{R_2}{R_2+R}V^+$$

$$= \frac{R_2}{R_2+R}\left[\frac{(1+\delta)}{1+\frac{\delta R_2}{R_2+R}} - 1\right]V^+$$

$$= \frac{R_2}{R_2+R}\left(\frac{R_S}{R_2+R+\delta R_2}\right)V^+$$

$$= \frac{R_2 \parallel R}{R_2+R}\left(\frac{\delta}{1+\frac{\delta R_2}{R_2+R}}\right)V^+$$

When $R_2 + R \gg \delta R_2$

$$v_{o1} \cong \frac{R_2 \parallel R}{R_2+R}\delta V^+$$

If $R_2 = R$

$$v_{o1} = \frac{\frac{R_2}{2}}{2R}\delta V^+ = \frac{\delta V^+}{4}$$