EE 320 Engr Electronics I

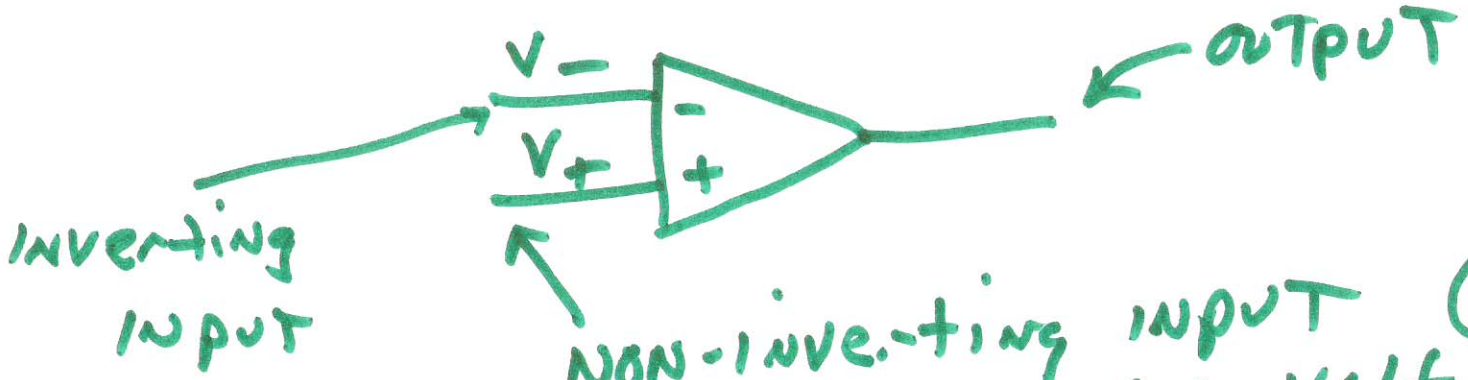
1/23/13 Lecture 1

2:30 - 3:45 PM

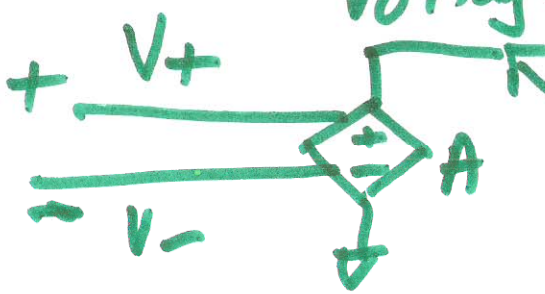
M-W

CBC C114

Op-Amp → operational Amplifier



Voltage-controlled voltage source (VCVS)



$V_{OUT} = A(V_+ - V_-)$

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1)

$$V_{OUT} = A_{OL} \cdot (V_+ - V_-)$$

A_{OL} ← GAIN

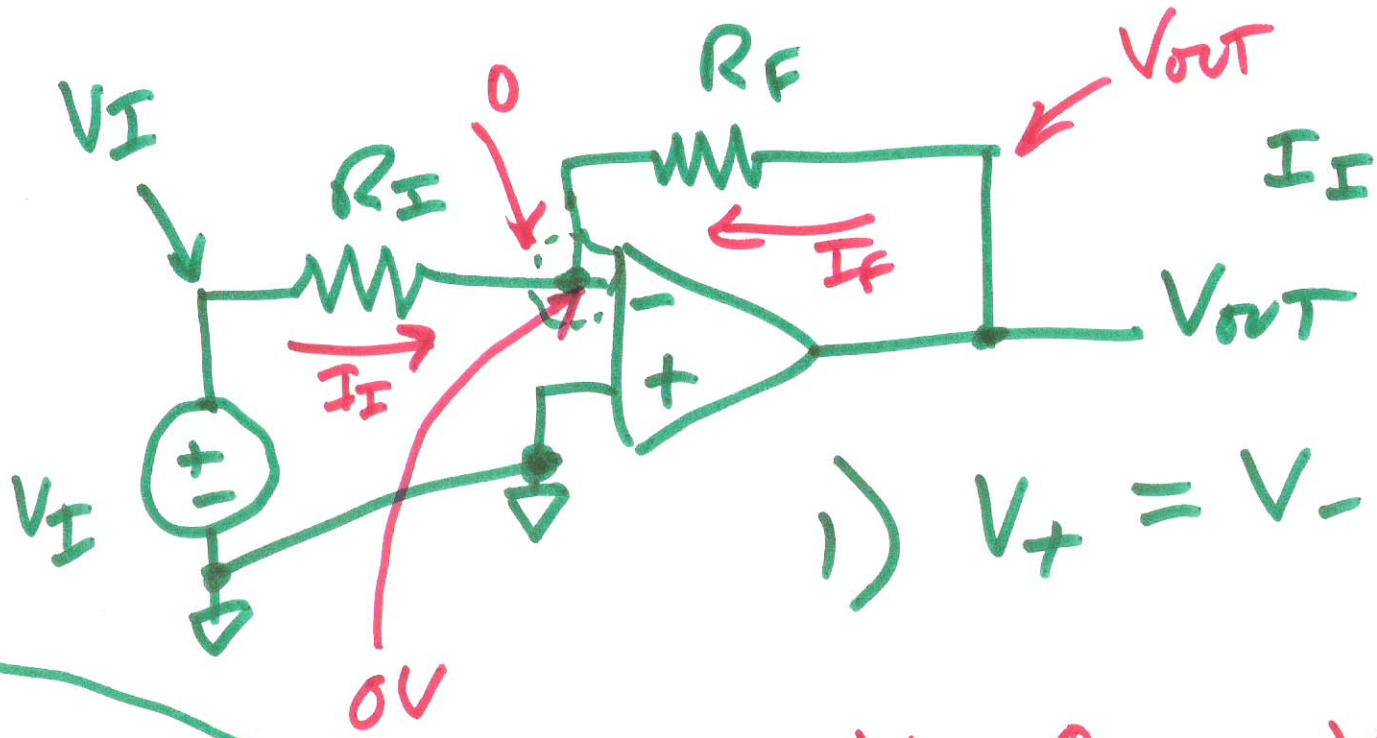
$$A_{OL} \to \infty$$

V_{OUT} finite

$$V_+ \approx V_-$$

$$V_+ - V_- \to 0$$

Inverting Amplifier



$I_I + I_f = 0$

1) $V_+ = V_-$

$$I_I = \frac{V_I - 0}{R_I} = \frac{V_I}{R_I}$$

$$I_f = \frac{V_{OUT} - 0}{R_f} = \frac{V_{OUT}}{R_f}$$

$I_f = -I_I$

$$\frac{V_I}{R_I} = -\frac{V_{OUT}}{R_f}$$

$$\frac{V_{OUT}}{V_I} = -\frac{R_f}{R_I}$$

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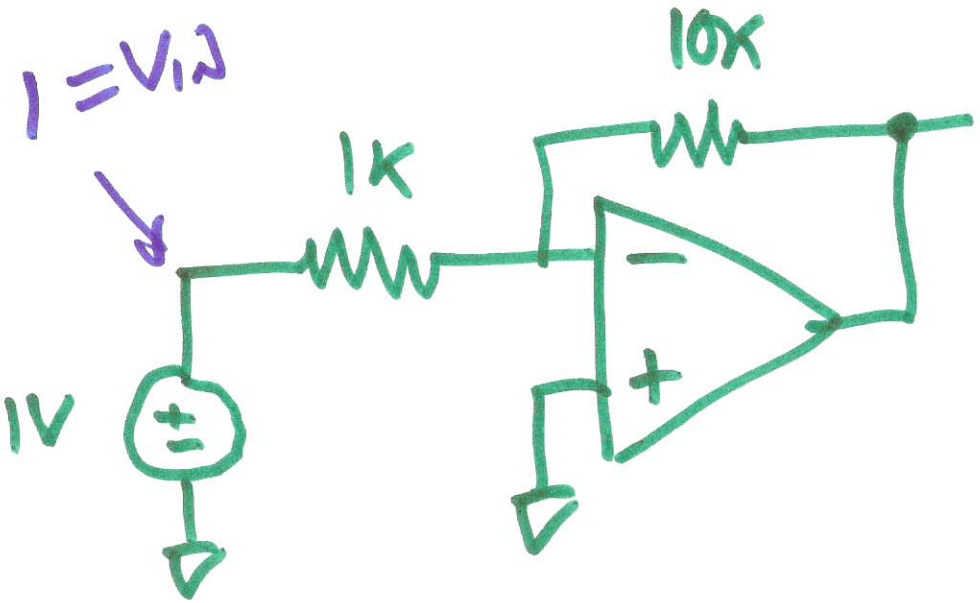
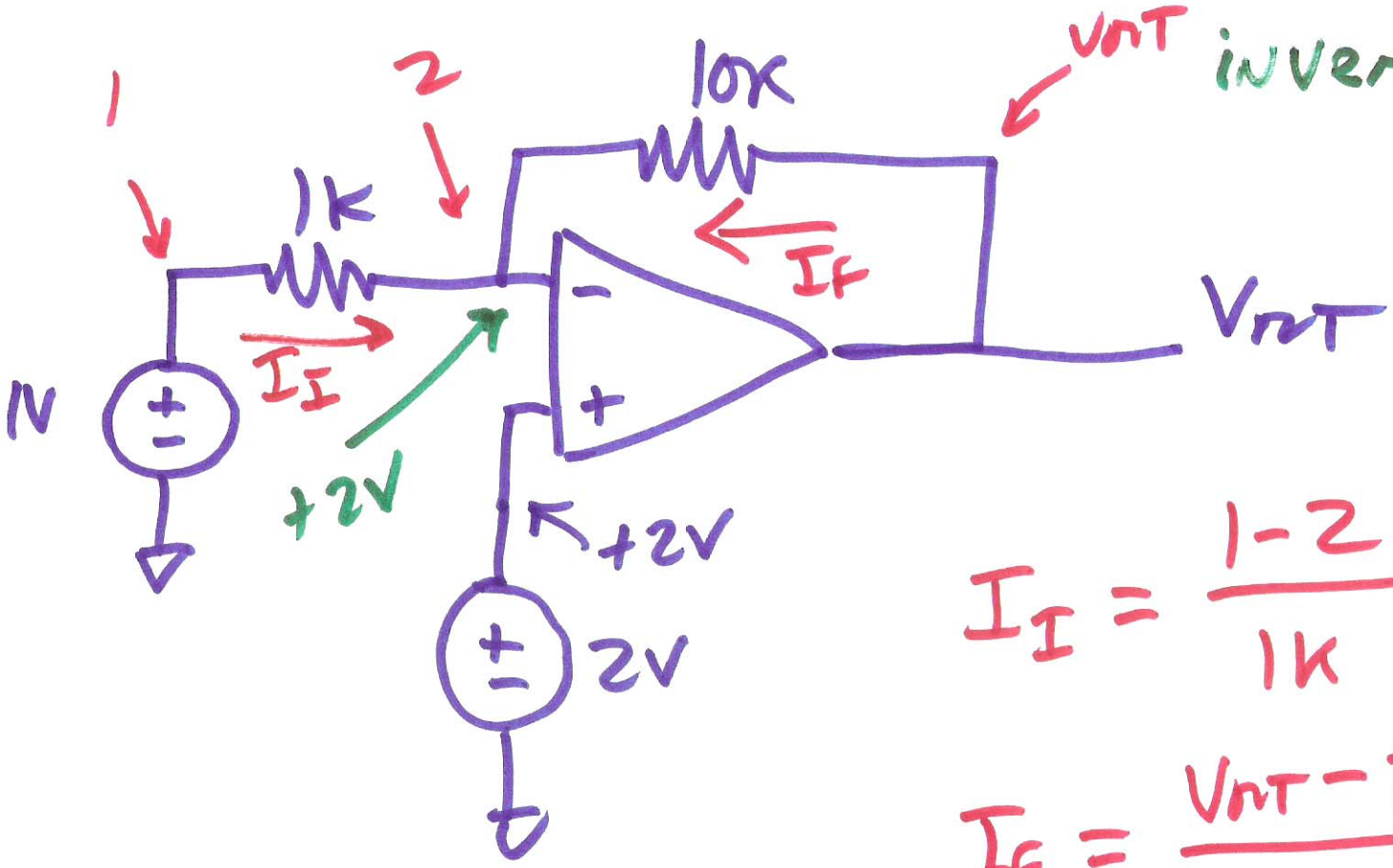
3)



$$\frac{V_{OUT}}{V_{in}} = \frac{-10K}{1K} = -10$$



$$I_I = \frac{1-2}{1K} = -1mA$$

$$I_F = \frac{V_{OUT}-2}{10K}$$

$$I_F = -I_I$$

$$\frac{V_{OUT}-2}{10K} = 1mA$$

$$V_{OUT}-2 = 10V$$

$V_{OUT} = 12$

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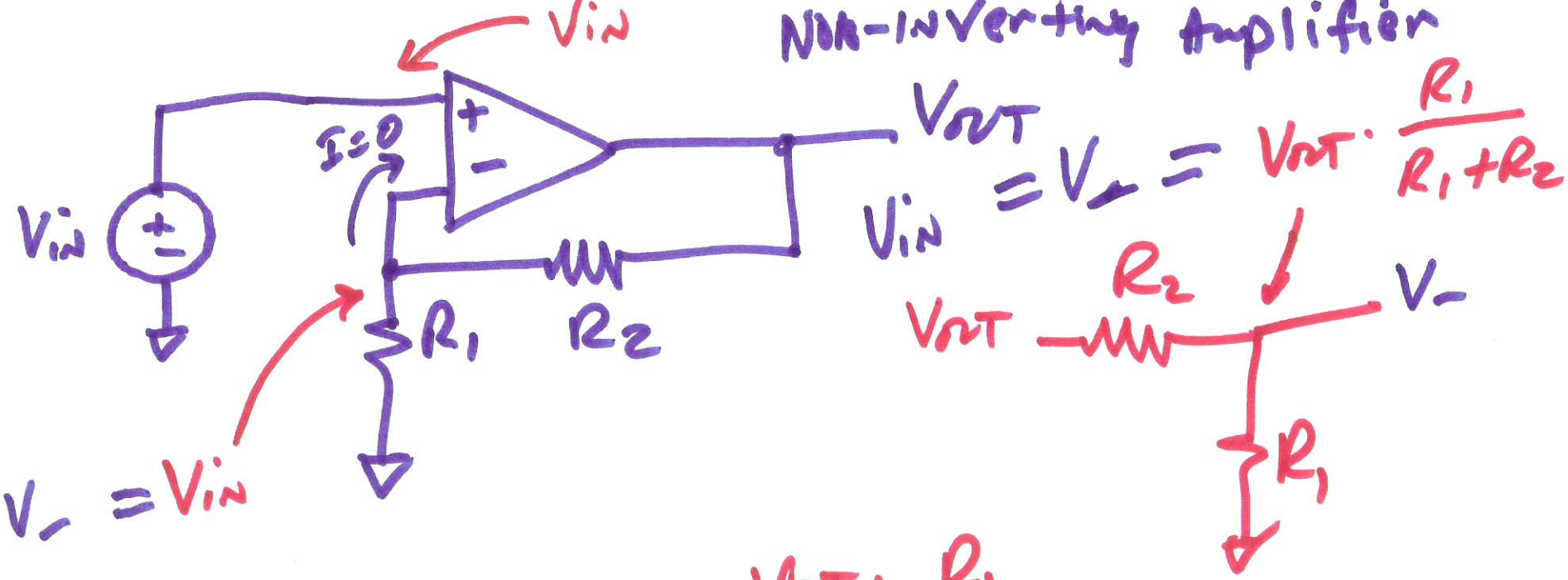
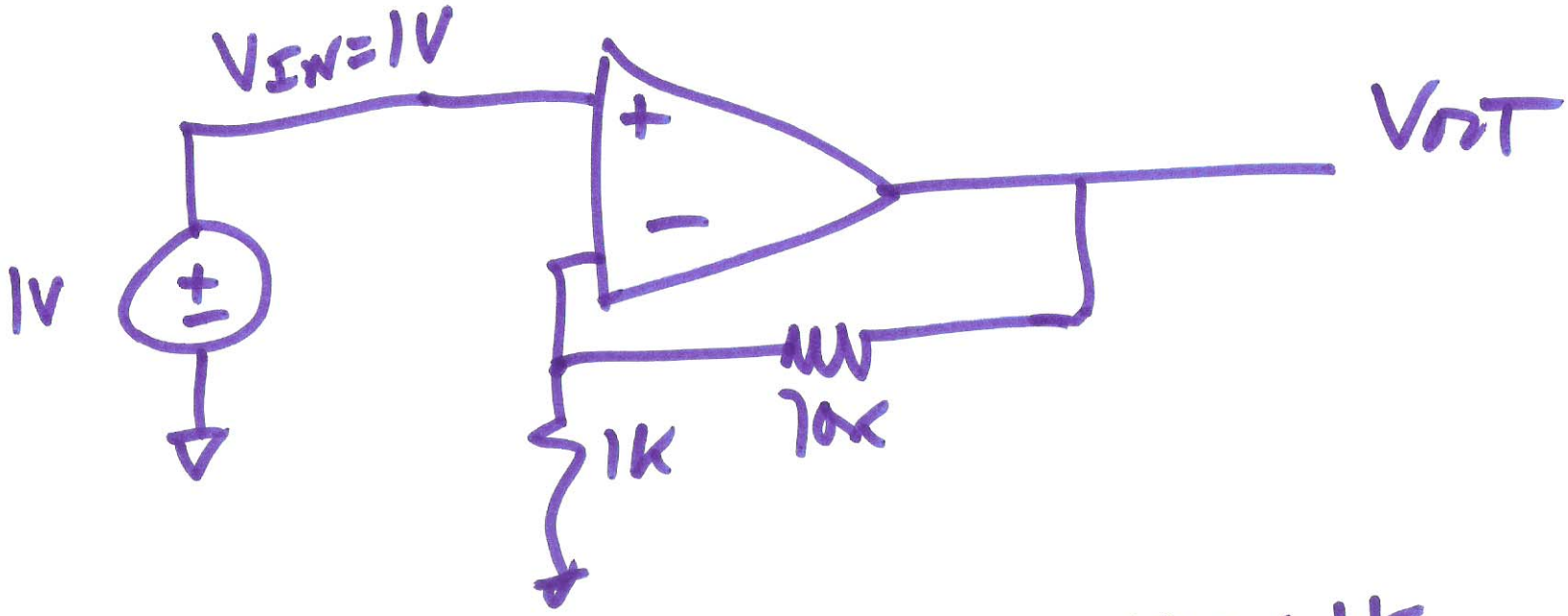
5)



$$V_{IN} = V_{OUT} \cdot \frac{R_1}{R_1+R_2}$$

$$\frac{V_{OUT}}{V_{in}} = \frac{R_1+R_2}{R_1} = 1 + \frac{R_2}{R_1}$$



$$\frac{V_{OUT}}{V_{IN}} = \frac{10K+1K}{1K} = 1+\frac{10}{1}$$

$$= 11$$

$$V_{IN} = 1V$$

$$V_{OUT} = \underline{\underline{11\ V}}$$

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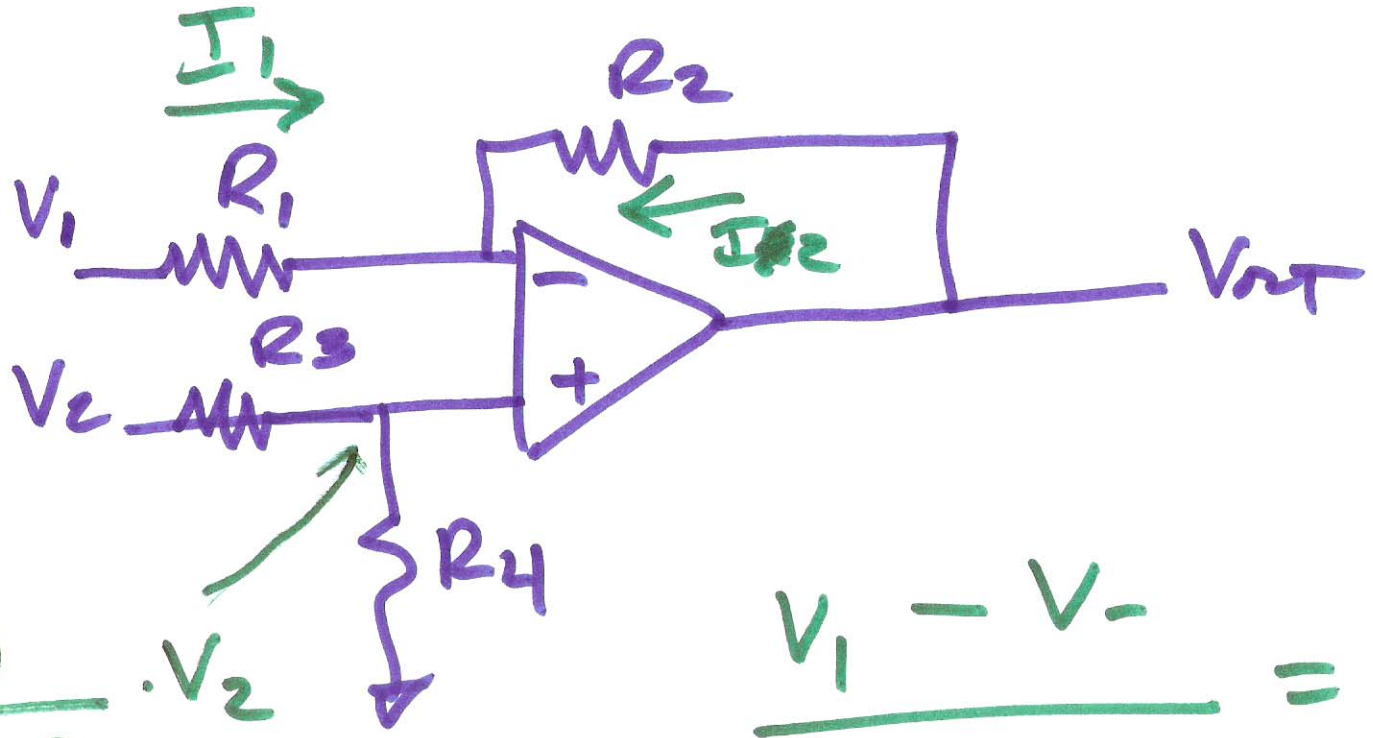

$$V_+ = \frac{R_4}{R_3 + R_4} \cdot V_2 = V_-$$

$$\frac{V_1 - V_-}{R_1} = I_1$$

$$I_2 = \frac{V_{OUT} - V_-}{R_2}$$

$$I_1 = -I_2$$

$$\frac{V_{in}^{1/2} - \frac{R_4}{R_3+R_4} \cdot V_2}{R_1} = \frac{\frac{R_4}{R_3+R_4} \cdot V_2 - V_{out}}{R_2}$$

I_1 $\quad -I_2$

$R_1 = R_2 = R_3 = R_4 = 1k$

$V_1 = 1\,V$

$V_2 = 2V$

$$V_{in}^{1} - \underbrace{\frac{1}{2} V_2}_{=1} = V_2 \cdot \frac{1}{2} - V_{out}$$

$1 \qquad\qquad 1$

$0 = 1 - V_{out}$

$V_{out} = 1$