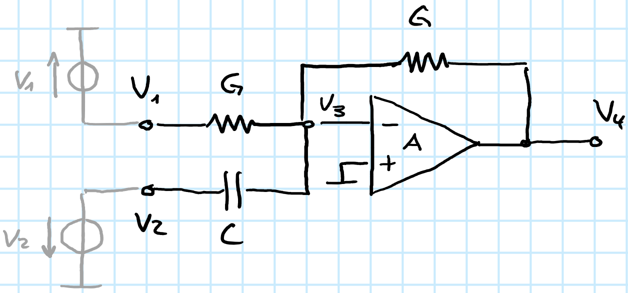
Signal-Flow Graphs in 12 Short Lessons

Exercise for Episode 4

Hanspeter Schmid, FHNW/IME

The circuit shown on the right has two input voltage sources. Draw all circuits that occur under source superposition, then draw the signal-flow graph, and calculate V_4 for $A \to \infty$.



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Solution for Episode 4

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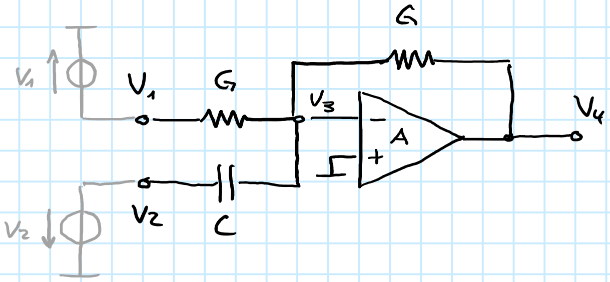
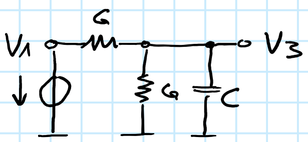


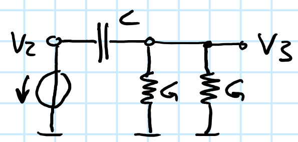
Solution Remember that the output of the OpAmp also is a voltage source. Then:

$V_1 \neq 0$
$V_2 = V_4 = 0$



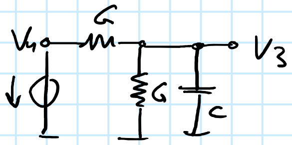
$$\frac{V_3}{V_1} = \frac{G}{2G + sC} = t_{13}$$

$V_2 \neq 0$
$V_1 = V_4 = 0$



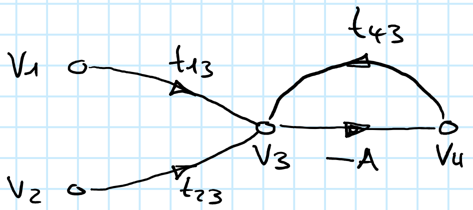
$$\frac{V_3}{V_2} = \frac{sC}{2G + sC} = t_{23}$$

$V_4 \neq 0$
$V_1 = V_2 = 0$



$$\frac{V_3}{V_4} = \frac{G}{2G + sC} = t_{43}$$

Graph:



Mason:

$$\frac{V_4}{V_1} = -\frac{A t_{13}}{1 + A t_{43}} \overset{A \to \infty}{\approx} -\frac{t_{13}}{t_{43}} = -1 = T_{14}$$

$$\frac{V_4}{V_2} = -\frac{A t_{23}}{1 + A t_{43}} \overset{A \to \infty}{\approx} -\frac{t_{23}}{t_{43}} = -\frac{sC}{G} = T_{24}$$

Superposition again:

$$V_4 = V_1 T_{14} + V_2 T_{24} = -\left(V_1 + \frac{sC}{G} V_2\right)$$

This circuit adds the differentiated V_2 to V_1.