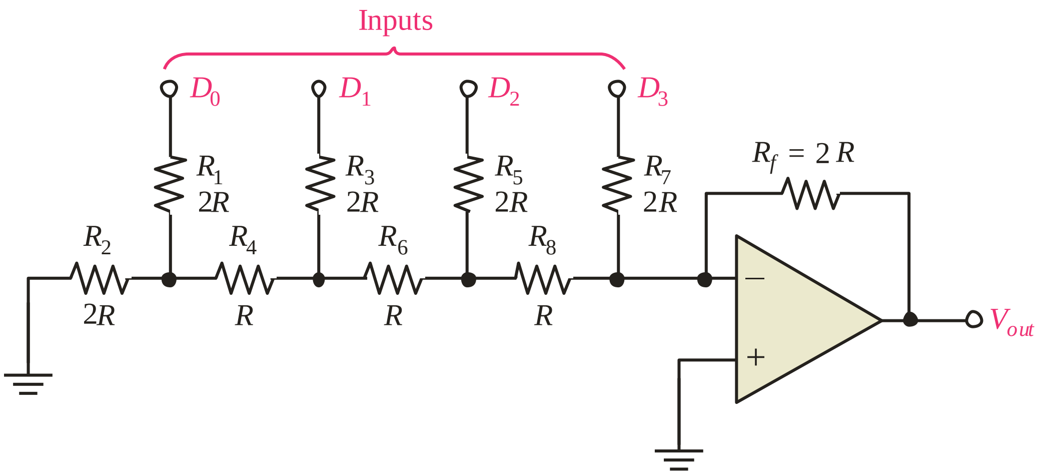
Lecture 13: Operational Amplifiers (4)

D/A Converters using OpAmps, Integrators, Differentiators, Examples

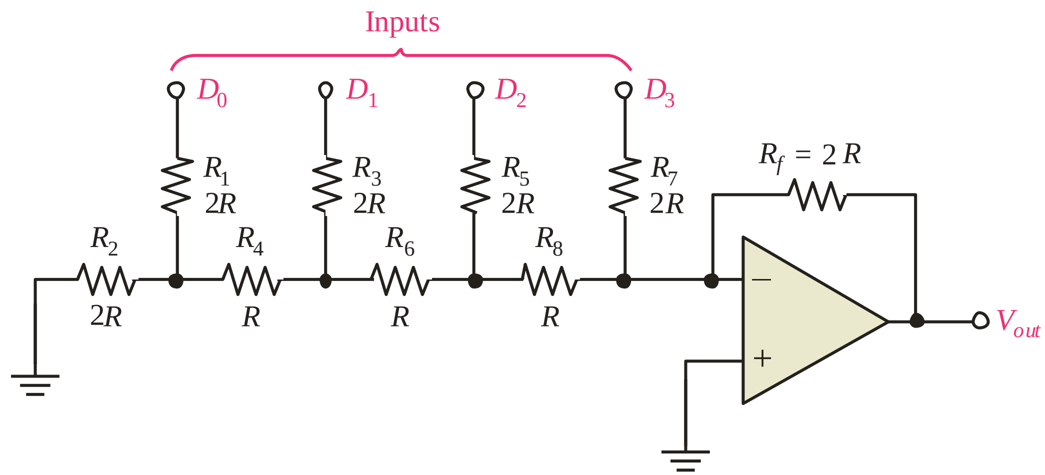
D/A Converter

A more widely used method for D/A conversion is the ***R*/2*R* ladder**. The gain for D_3 is -1. Each successive input has a gain that is half of previous one. The output represents a weighted sum of all of the inputs (similar to the scaling adder).

An advantage of the *R*/2*R* ladder is that only two values of resistors are required to implement the circuit.

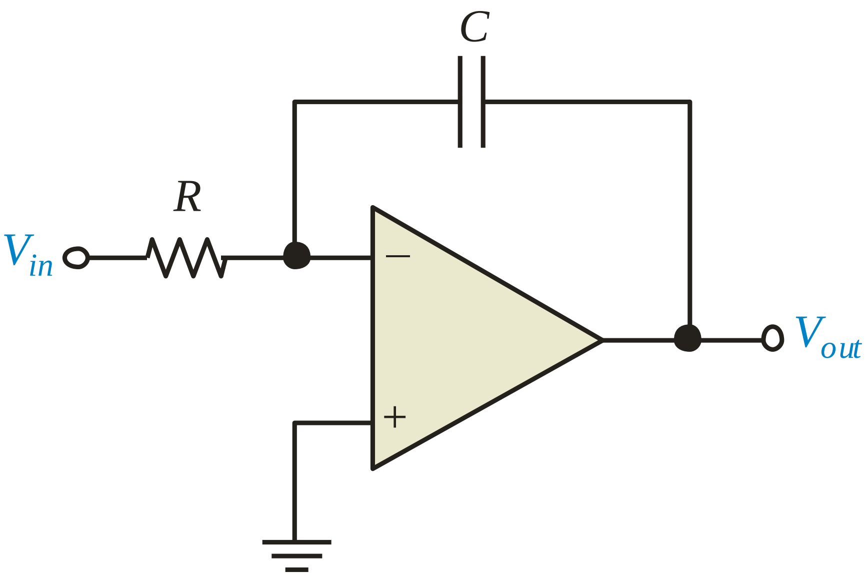


Analysis of the D/A



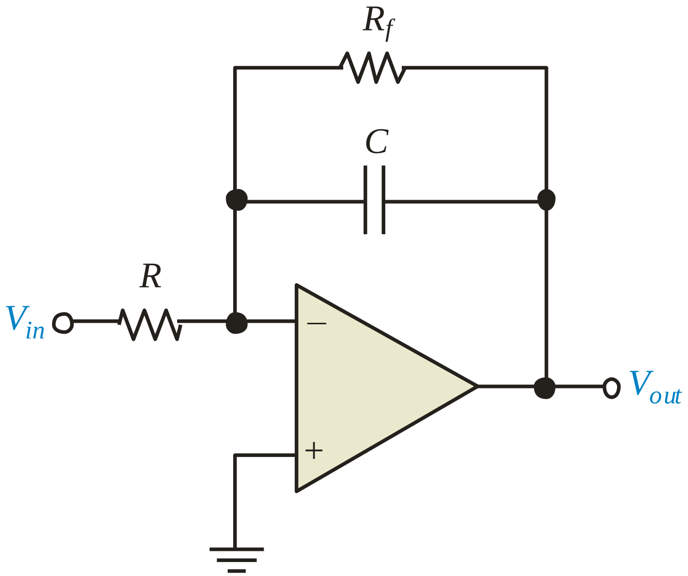
Ideal Integrator

The **ideal integrator** is an inverting amplifier that has a capacitor in the feedback path. The output voltage is proportional to the negative integral (running sum) of the input voltage.

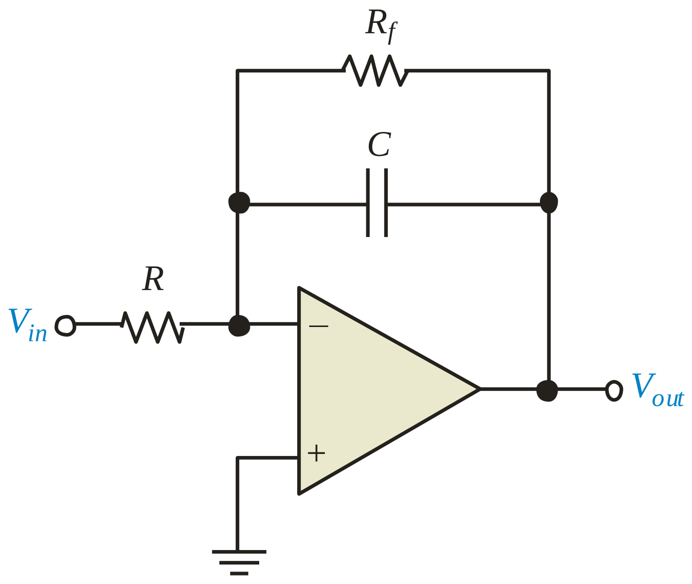


Practical Integrator

Op-amp integrating circuits must have extremely low dc offset and bias currents, because small errors are equivalent to a dc input. The ideal integrator tends to accumulate these errors, which moves the output toward saturation. The **practical integrator** overcomes these errors– the simplest method is to add a relatively large feedback resistor.

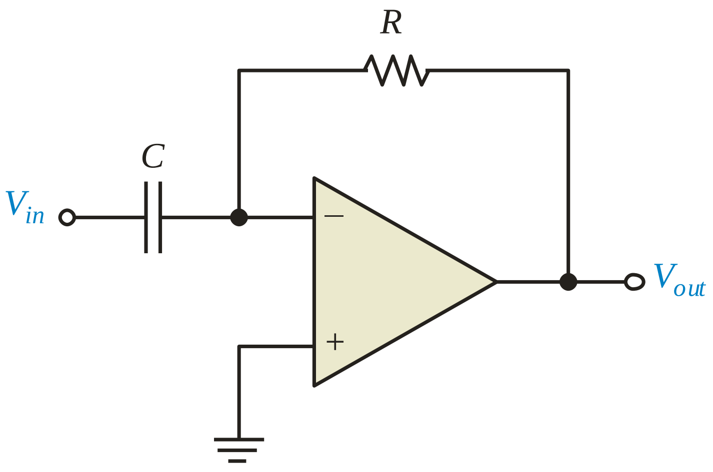


Analysis of Practical Integrator



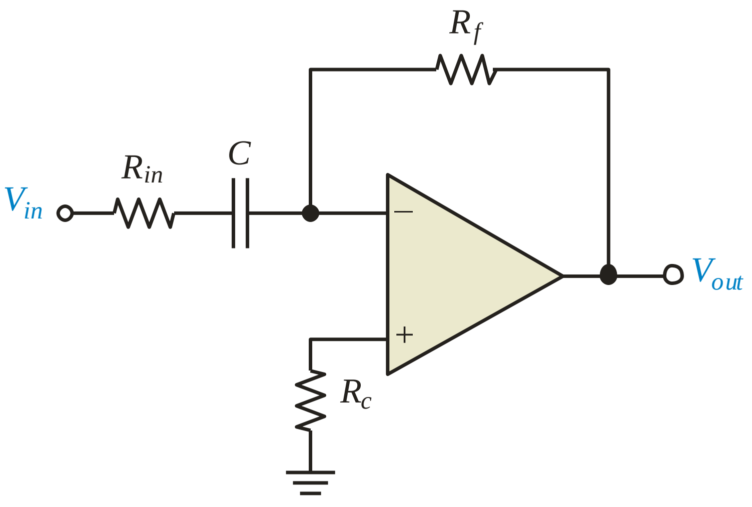
Ideal OpAmp Differentiator

The **ideal differentiator** is an inverting amplifier that has a capacitor in the input path. The output voltage is proportional to the negative rate of change of the input voltage.



Practical OpAmp Differentiator

The small reactance of *C* at high frequencies means an ideal differentiator circuit has very high gain for high-frequency noise. To compensate for this, a small series resistor is often added to the input. This **practical differentiator** has reduced high frequency gain and is less prone to noise.



Analysis of the Practical Differentiator