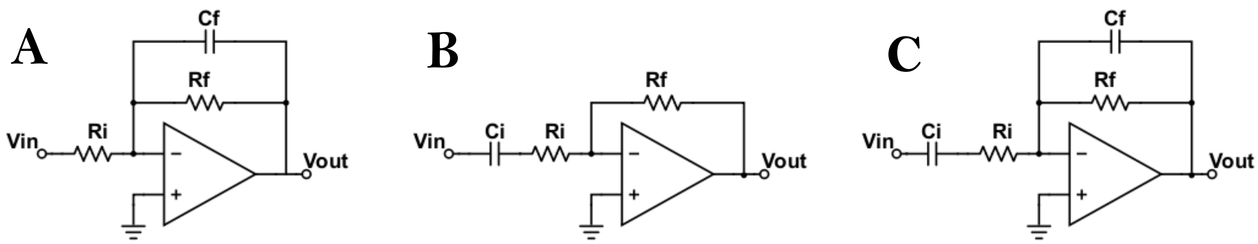
Active Filters—Inverting Configuration

Active filters are a two-for-one: amplifier and filter action all in one fell swoop. Three common configurations are shown below.



1. What is the impedance of a capacitor? What element does it act like in limiting frequency cases?
For each filter:

2. Draw the circuit replacing the capacitor with limiting case behavior ($\omega = 0; \quad \omega \to \infty$)

3. What type of filter is A, B, C?

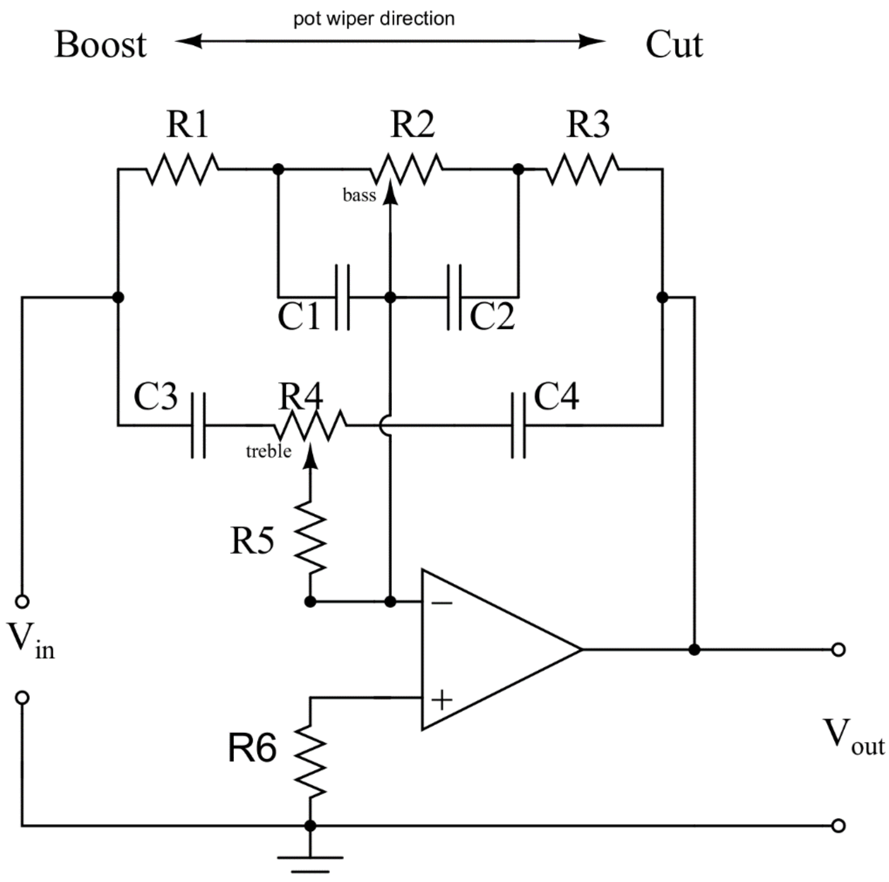
4. Derive the transfer function $\boldsymbol{H}(\omega)$.

5. Compute the cutoff frequency(-ies) for each filter given that:
R_f = 220 kΩ; R_i = 2.2 kΩ; C_i = 2.2 μF; C_f = 1.4 nF

6. Sketch the magnitude (decibel gain) and phase response for each filter

Baxandall Tone Control

Shown below is the Baxandall tone control circuits (invented by P. Baxandall 1952). It is widely implemented in audio gear as it allows the listener to independently adjust bass and treble by turning two knobs (pots R2 and R4). Component values are listed below.



C1	C2	C3	C4	R1	R2	R3	R4	R5
47 nF	47 nF	10 nF	10 nF	10 kΩ	100 kΩ pot	10 kΩ	22 kΩ pot	2.2 kΩ

1. Carefully draw the elements involved in just the bass-control circuitry
2. Do the same, but for the treble circuitry alone.
3. Now take just the bass circuit alone, assume the pot is turned all the way to boost. Derive the transfer function, then sketch the decibel gain G(f) over the human audible range of frequencies f = 10 Hz – 20,000 Hz.