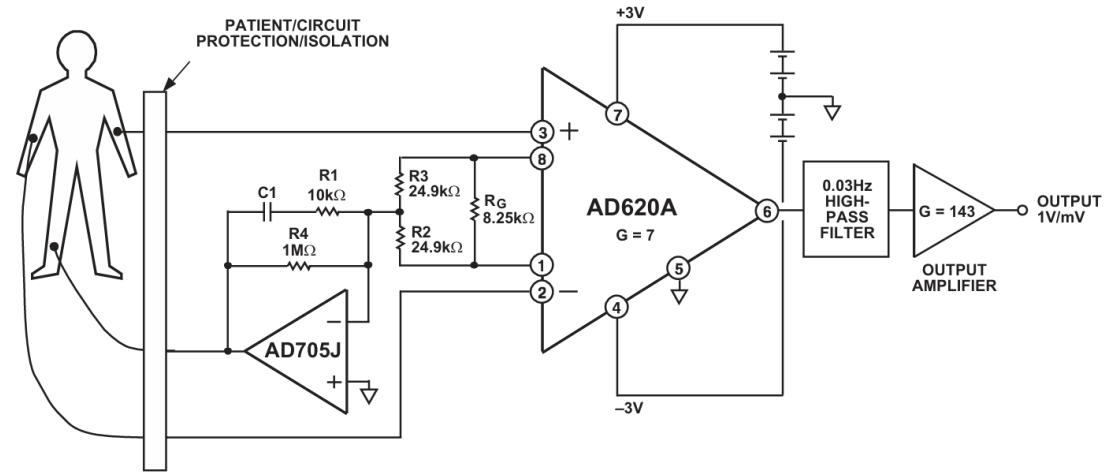
Regarding how to acquire ECG signals from skin, Analog Devices, Inc. (ADI) provides a classic example:



Staring from the left side of the flowchart, we first observe three electrodes positioned on the left arm (LA), right arm (RA), and right leg (RL), which are responsible for transmitting signals from these locations.

Moving to the right, the RL electrode is connected to an operational amplifier (AD705J). Together with resistors R1, R2, R3, R3 and Rg , and capacitor C1, it forms the well-known **Right Leg Drive (RLD) circuit** to suppress common-mode interference.

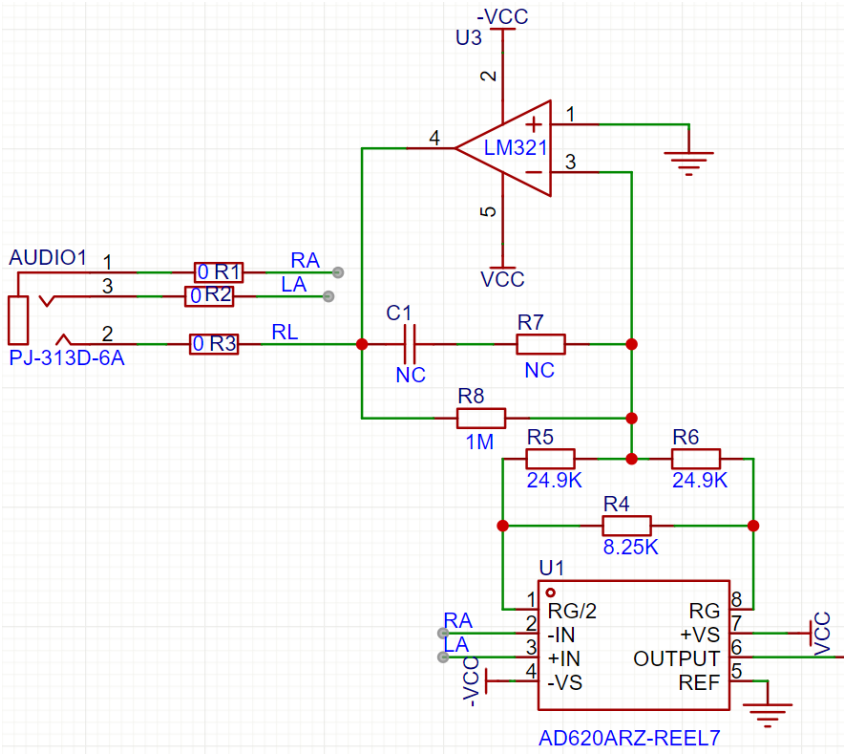
Next, the **instrumentation amplifier (AD620A)** comes into play. Its Pin 2 and Pin 3 are connected to the LA and RA electrodes, respectively, amplifying the differential signal by a factor of 7. Given the high impedance of human skin and other challenges, the AD620's **high input impedance** and **high common-mode rejection ratio (CMRR)** make it an

ideal choice for ECG signal acquisition.

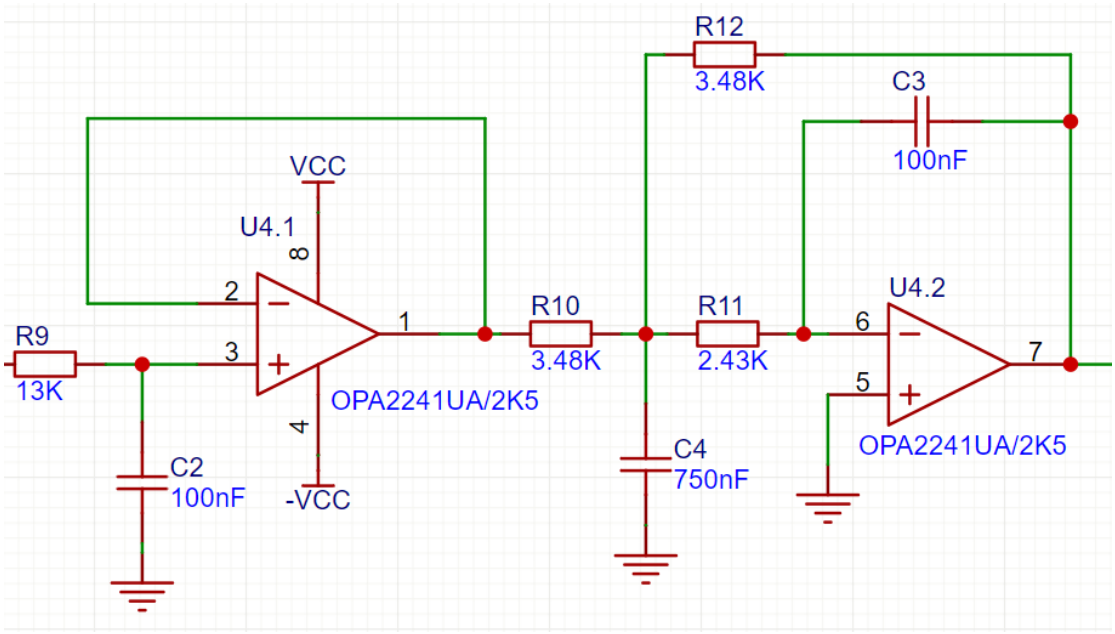
Proceeding further, the signal passes through a **0.03 Hz high-pass filter** to eliminate baseline drift and low-frequency noise.

Finally, the signal undergoes an additional amplification stage (143x7 gain) before being output for further processing or analysis.

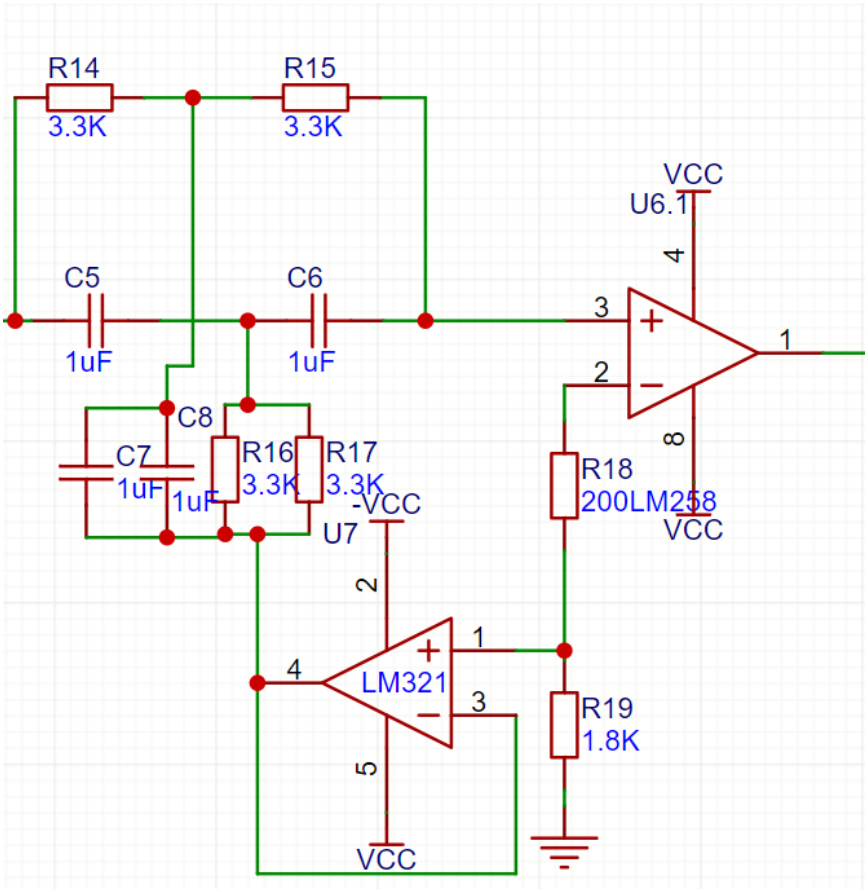
In the schematic I designed, several modifications have been made to the mentioned signal chain. Specifically, a 150Hz low-pass filter and a 50Hz dual-T notch filter are incorporated to suppress mains interference (50 Hz) and EMG interference. Additionally, the signal amplification gain has been adjusted accordingly.



In this design, I utilized the **LM321** as the operation amplifier(op-amp) for the **Right Leg Drive (RLD) circuit**. While you can naturally opt other suitable op-amps---ideally those with high input impedance and high common-mode rejection ratio (CMRR), such as the previous mentioned AD705J---I choose LM321 because it was readily available to me and is cost-effective.



The 150 Hz low-pass filter constructed here using the **OPA2241** is designed to eliminate interference from EMG signals and other high-frequency noise. For the **750 nF capacitor** in this circuit, polypropylene capacitors are recommended, as ceramic or electrolytic capacitors typically do not reach such a high capacitance value (750 nF) while maintaining stability and performance.



A 50 Hz active Twin-T notch filter is implemented here to suppress power-line interference. If your region operates on a 60 Hz mains frequency, you can adjust the component values accordingly.

This covers the **analog front-end (AFE) for ECG systems**, detailing critical components such as instrumentation amplifiers, filters and drive circuits for high-fidelity biopotential signal acquisition.