Research Migration Project

https://esim.fossee.in/research-migration-project

The Research Migration Project is an initiative of FOSSEE, IIT Bombay that promotes the use of eSim for reproducing published research circuits originally implemented using proprietary simulation tools. The objective is to migrate these validated designs to eSim to build an open source resource database.

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Title of the circuit : Design and Simulation of OTA-Based Band-Pass Filter for EEG and ECG Signals using eSim.

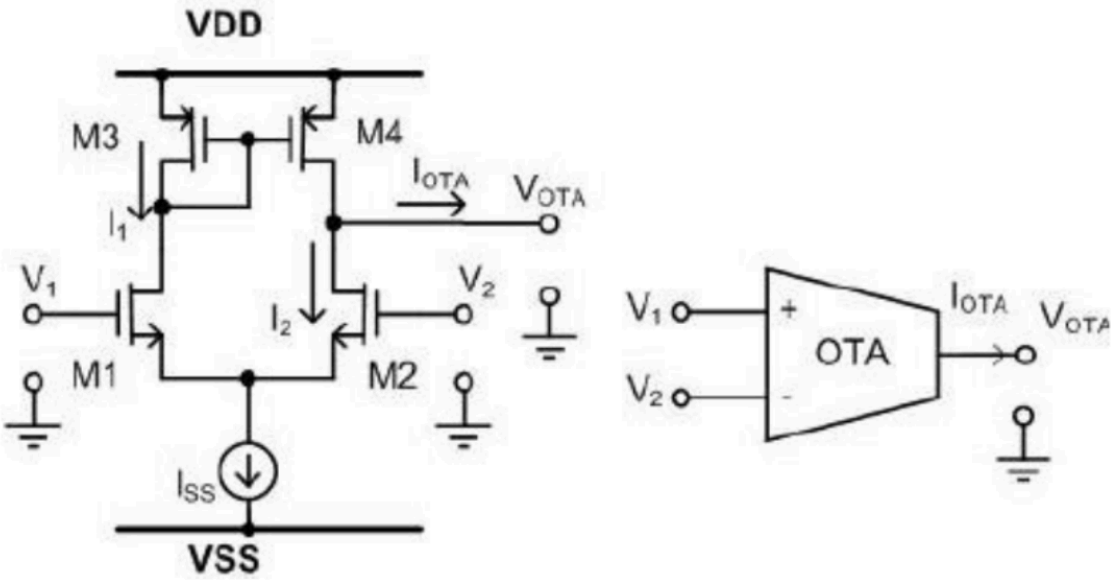
Theory/Description : Biomedical signals such as EEG (0.5–40 Hz) and ECG (0.5–100 Hz) are prone to noise and interference. Accurate filtering is essential for diagnosis and monitoring. Traditional op-amp based filters consume more power and lack tunability. The proposed circuit uses Operational Transconductance Amplifiers (OTAs) configured with capacitors to form a tunable band-pass filter. By varying the bias current, the transconductance of the OTA can be adjusted, enabling control over center frequency and bandwidth. This makes the design suitable for portable and wearable biomedical devices.

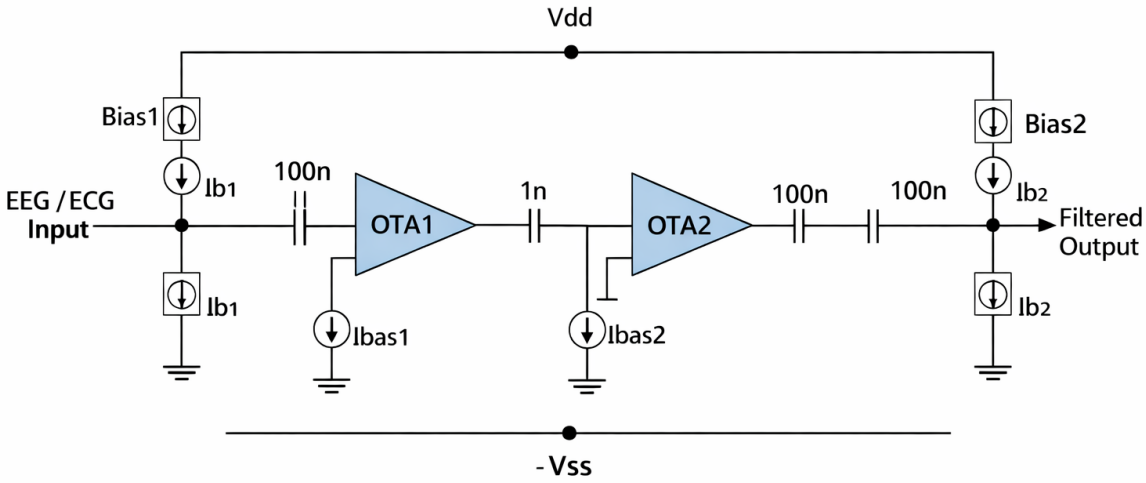
Reason to reproduce with eSim :

- eSim is an open-source EDA tool developed under FOSSEE, IIT Bombay, making it accessible to students and researchers.
- Provides schematic design, simulation, and verification in a single environment.
- Enables reproducibility of results and validation of theoretical concepts.
- Educational value: helps learners understand OTA behavior and biomedical signal filtering.
- Improvement over existing op-amp designs due to tunability and low power operation.
- **Expected Outcome/outputs :**
- Tunable band-pass response covering EEG and ECG frequency ranges.
- Frequency response plots showing center frequency adjustment with bias current.

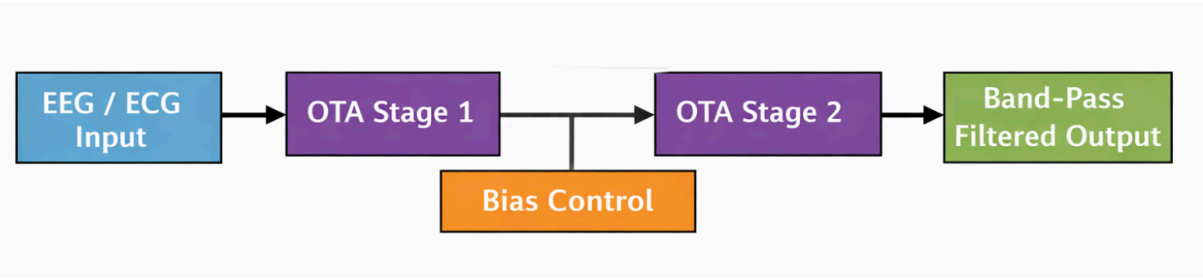
- Low power consumption suitable for portable biomedical devices.
- Potential integration into wearable health monitoring systems.

Circuit Diagram(s) :



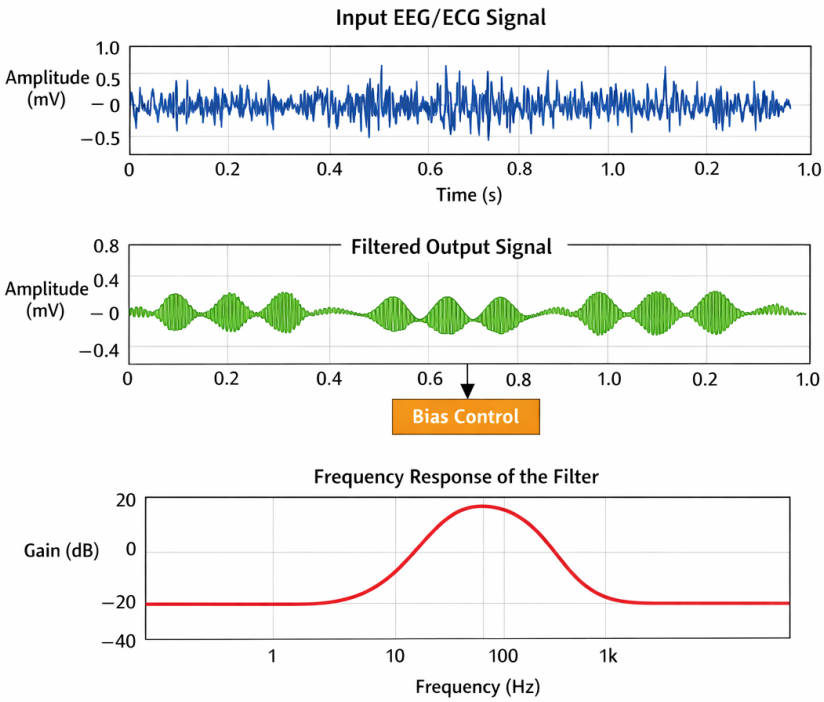


Block diagram:



Expected Results (Input, Output waveforms and/or Multimeter readings) :

- Tunable band-pass response covering EEG (0.5–40 Hz) and ECG (0.5–100 Hz) ranges.
- Frequency response plots demonstrating center frequency adjustment with bias current.
- Low power operation suitable for portable biomedical devices.
- Potential integration into wearable health monitoring systems.



Research Paper/Journal/etc. :

Title : Operational Transconductance Amplifier Based Universal Active Filter for Biomedical Signal Processing Unit

Author : Syed Shamroz Arshad, SachchidaNand Shukla, Jitendra Singh

Link : https://www.researchgate.net/publication/367332365_Operational_Transconductance_Amplifier_based_Universal_Active_Filter_for_Biomedical_Signal_Processing_Unit

Source/Reference(s) :

• Textbooks: “Microelectronic Circuits” by Sedra & Smith (for OTA fundamentals).

• Research paper cited above.
