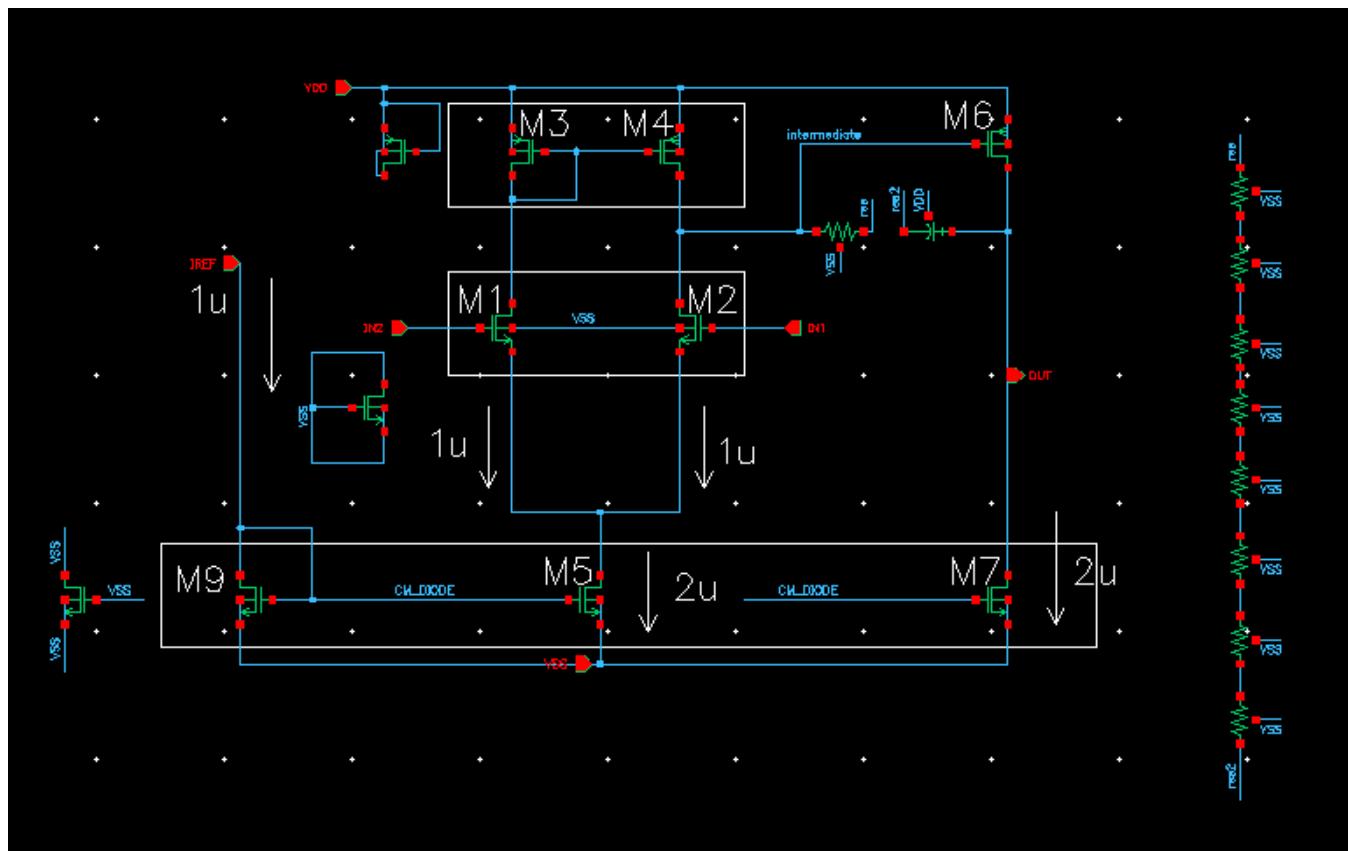


Two – Stage CMOS Operational Amplifier Design

This document presents the complete design flow of a Two-Stage CMOS Operational Amplifier, including schematic development, layout implementation, matching strategies, routing methodology, and verification checks. The design emphasizes high gain, precise current control, device matching, and layout symmetry to ensure reliable analog performance.

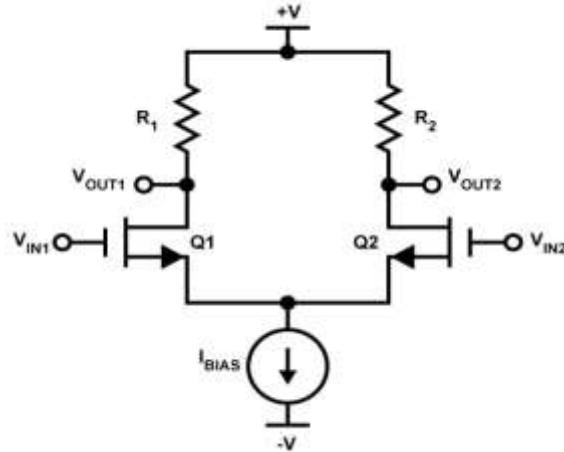
Schematic of the Two-Stage Op-Amp



The op-amp consists of

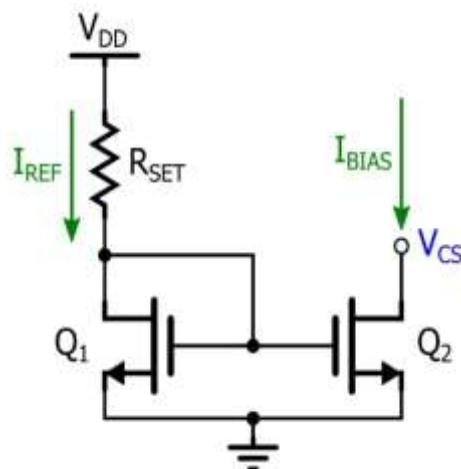
Differential Pair

- Common Centroid placement is used to ensure both transistors experience the same process variations.
- Dummy devices are added at the edges to maintain uniform diffusion and reduce mismatch.
- Metal routing is kept equal in length and symmetric to avoid parasitic imbalance.

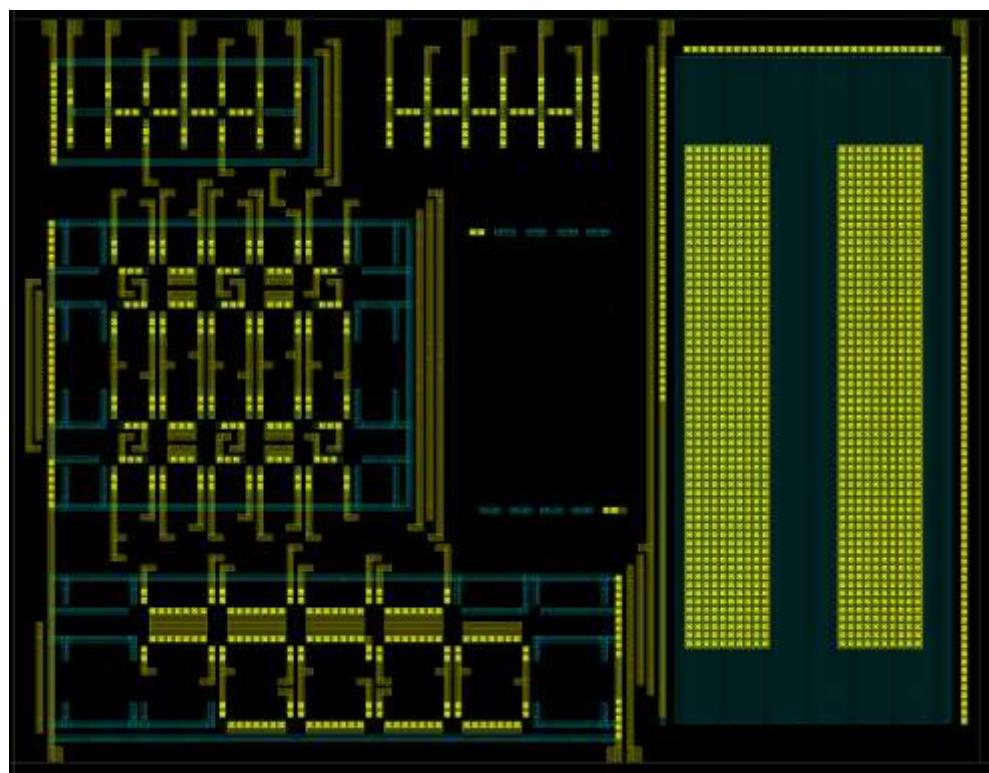


Current Mirror

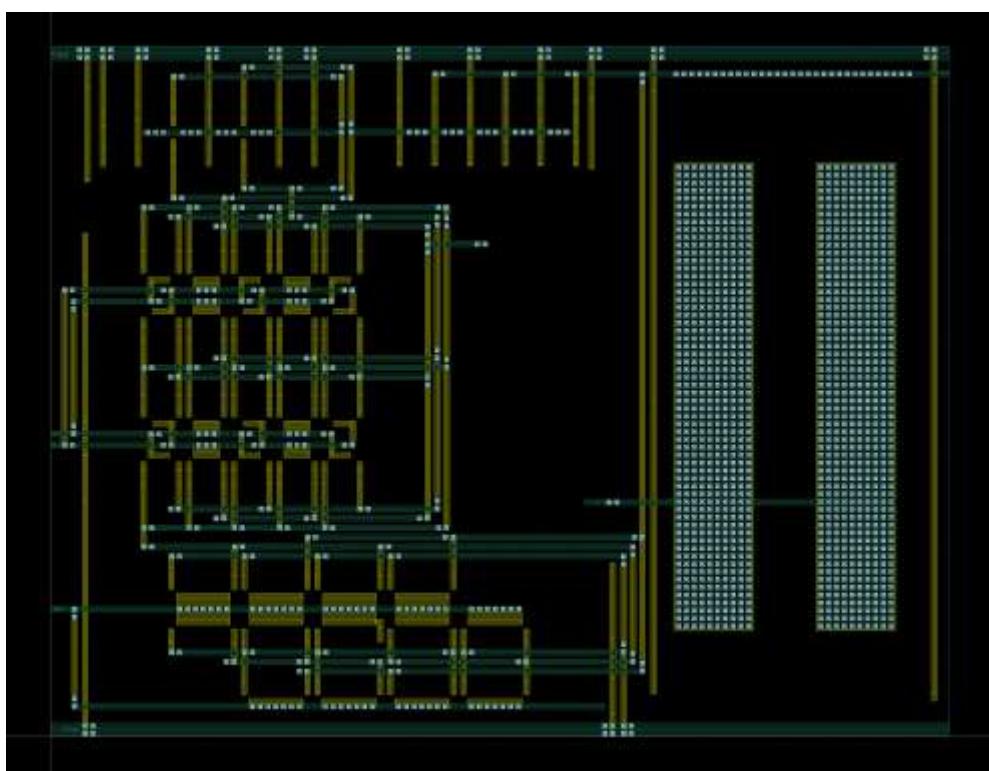
- Current mirrors are designed for stable biasing and accurate current replication.
- Common Centroid is used for the main mirror, and Interdigitation is applied for the tail mirror to improve matching.
- Metal routing is kept uniform and equal to avoid parasitic mismatches and ensure stable performance.



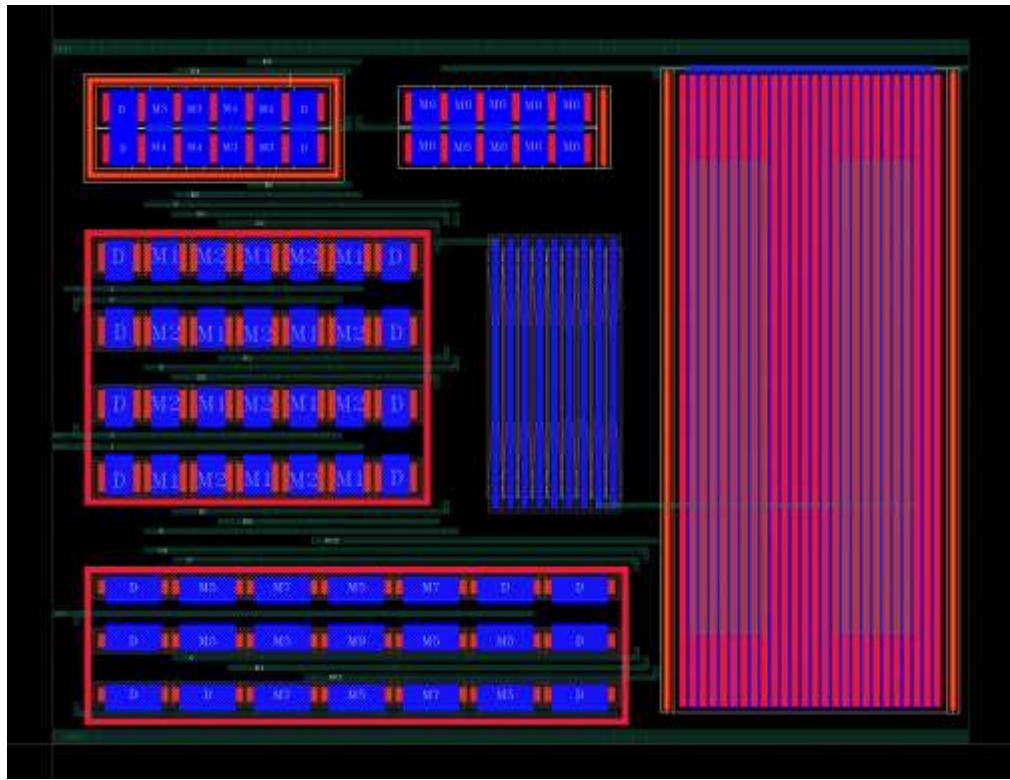
Routing for M1, M2



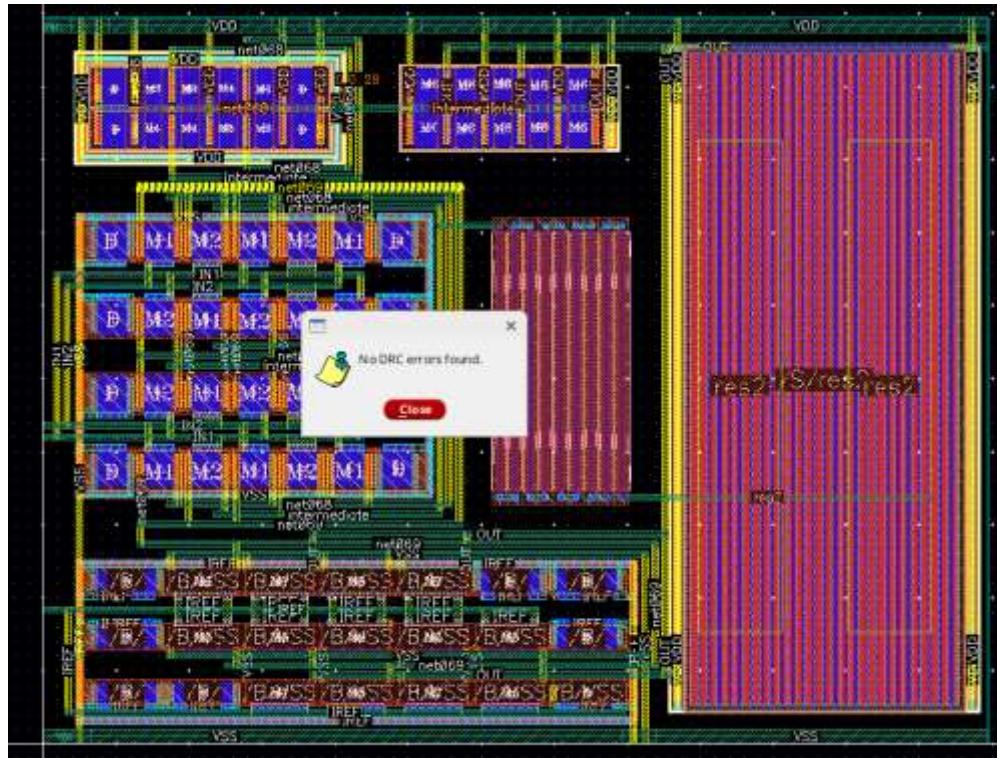
Routing for M2, M3



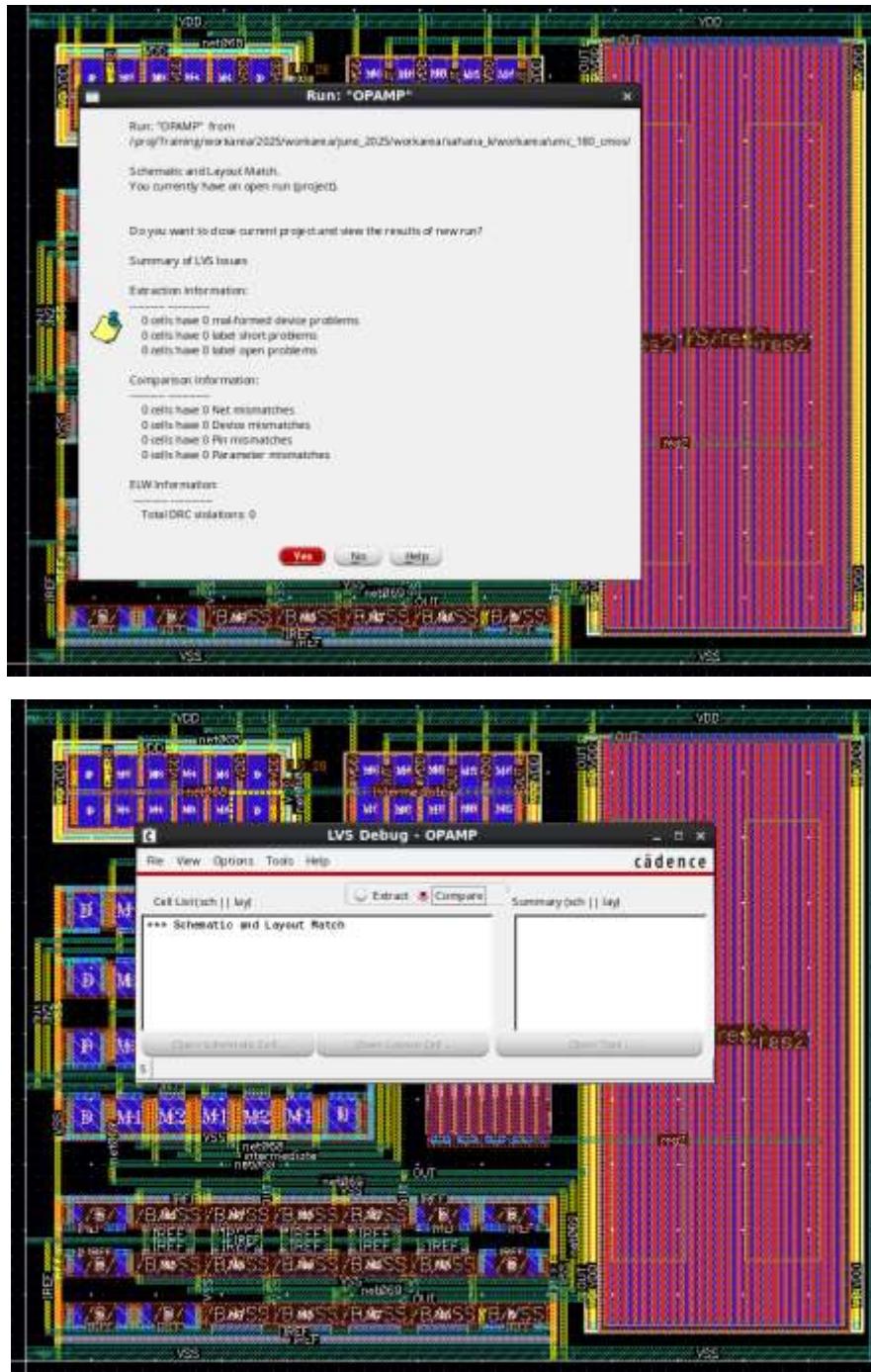
Routing with M3 for All the connected blocks



DRC Verification



LVS Verification

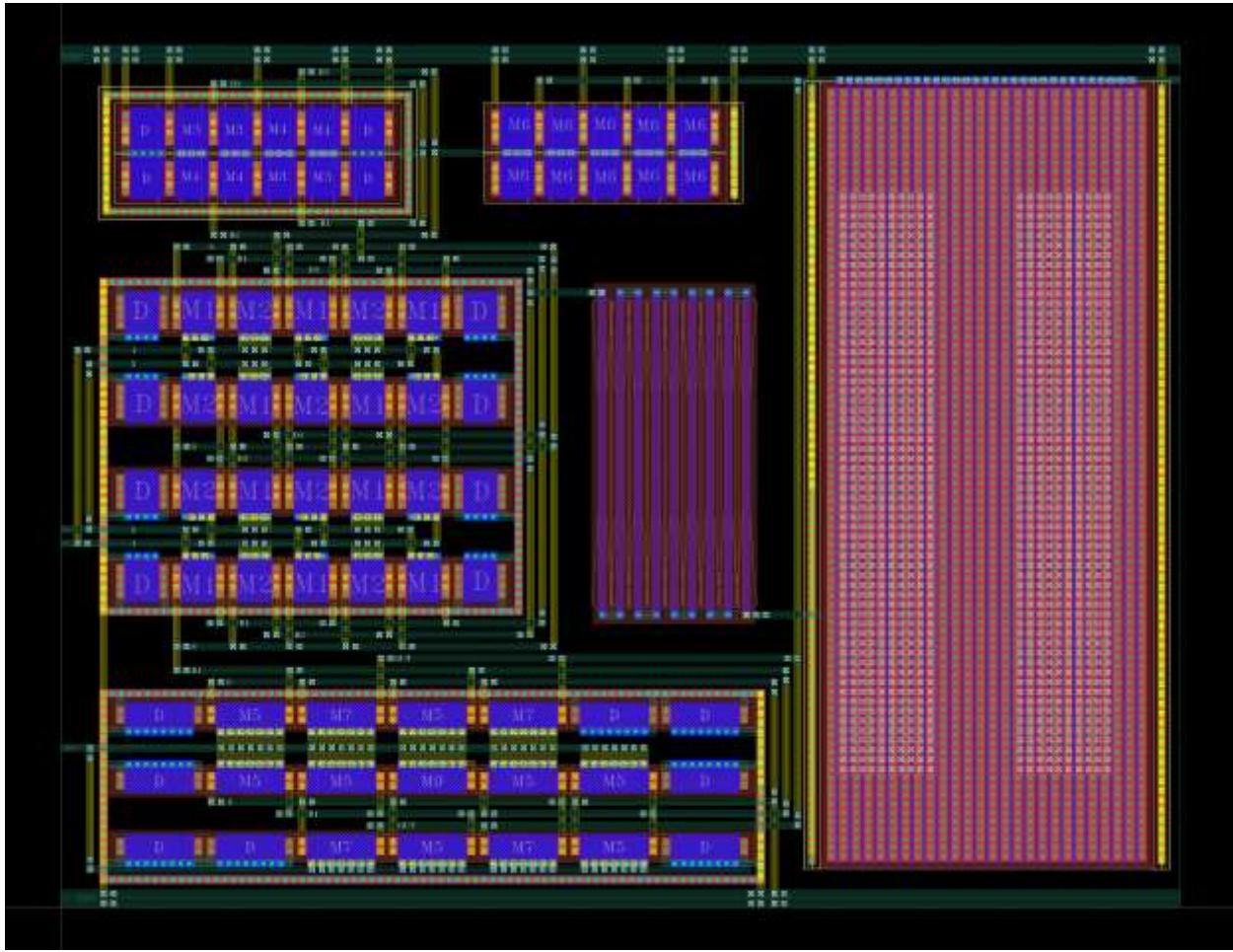


DRC and LVS

DRC passed → No layout violations.

LVS passed → Layout matches schematic connectivity correctly.

Final Op-Amp Layout



The final layout is balanced and symmetric, with clean routing, guard rings, and dummy devices applied to maintain matching. This ensures reliable operation, stable gain, and reduced offset.

Conclusion

The Two-Stage CMOS Operational Amplifier is successfully designed and verified. By applying:

- Common-Centroid Matching
- Interdigititation
- Guard Rings
- Dummy Devices

the design achieves high accuracy, stable biasing, and strong analog performance. This makes the op-amp suitable for precision analog systems and low-noise signal processing applications.