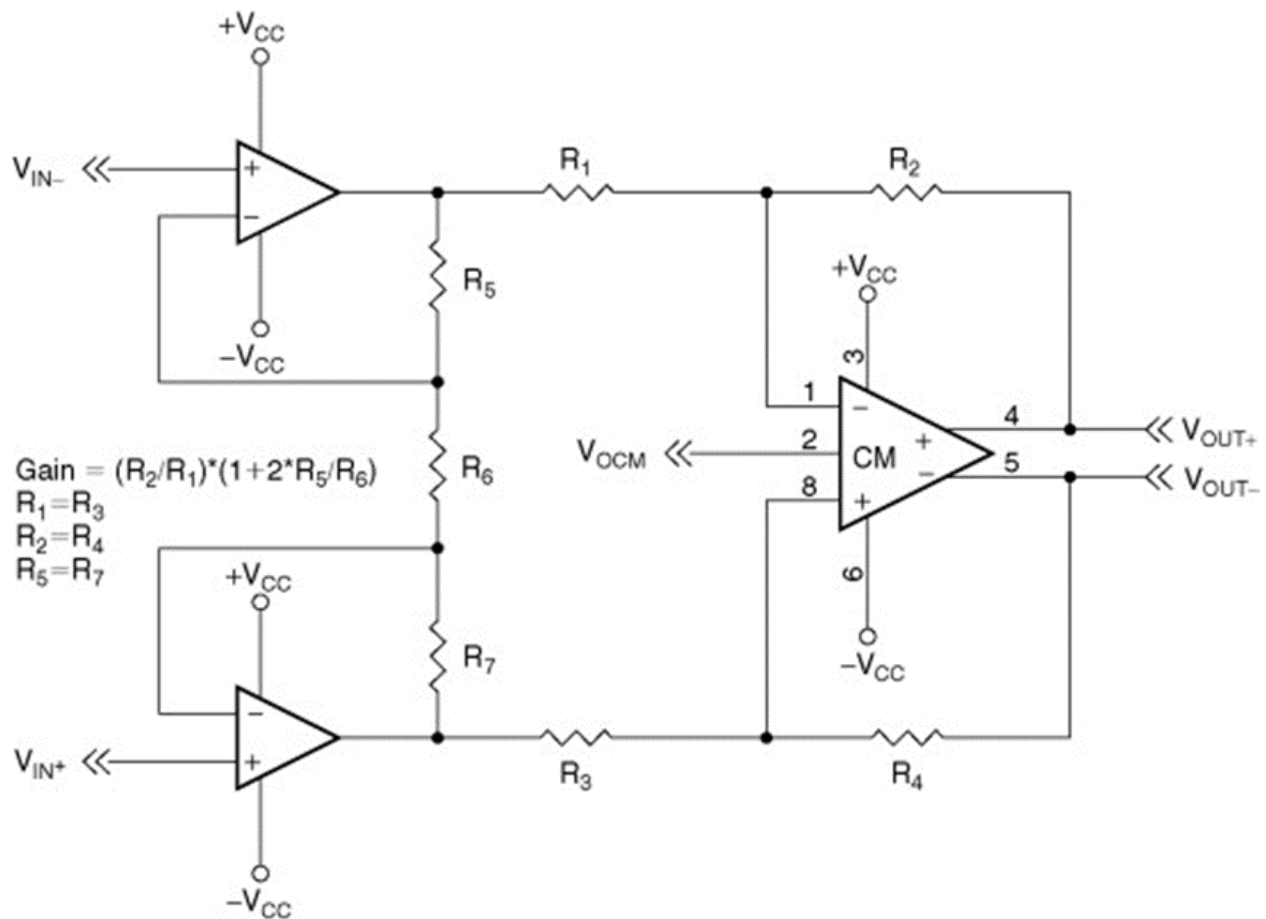


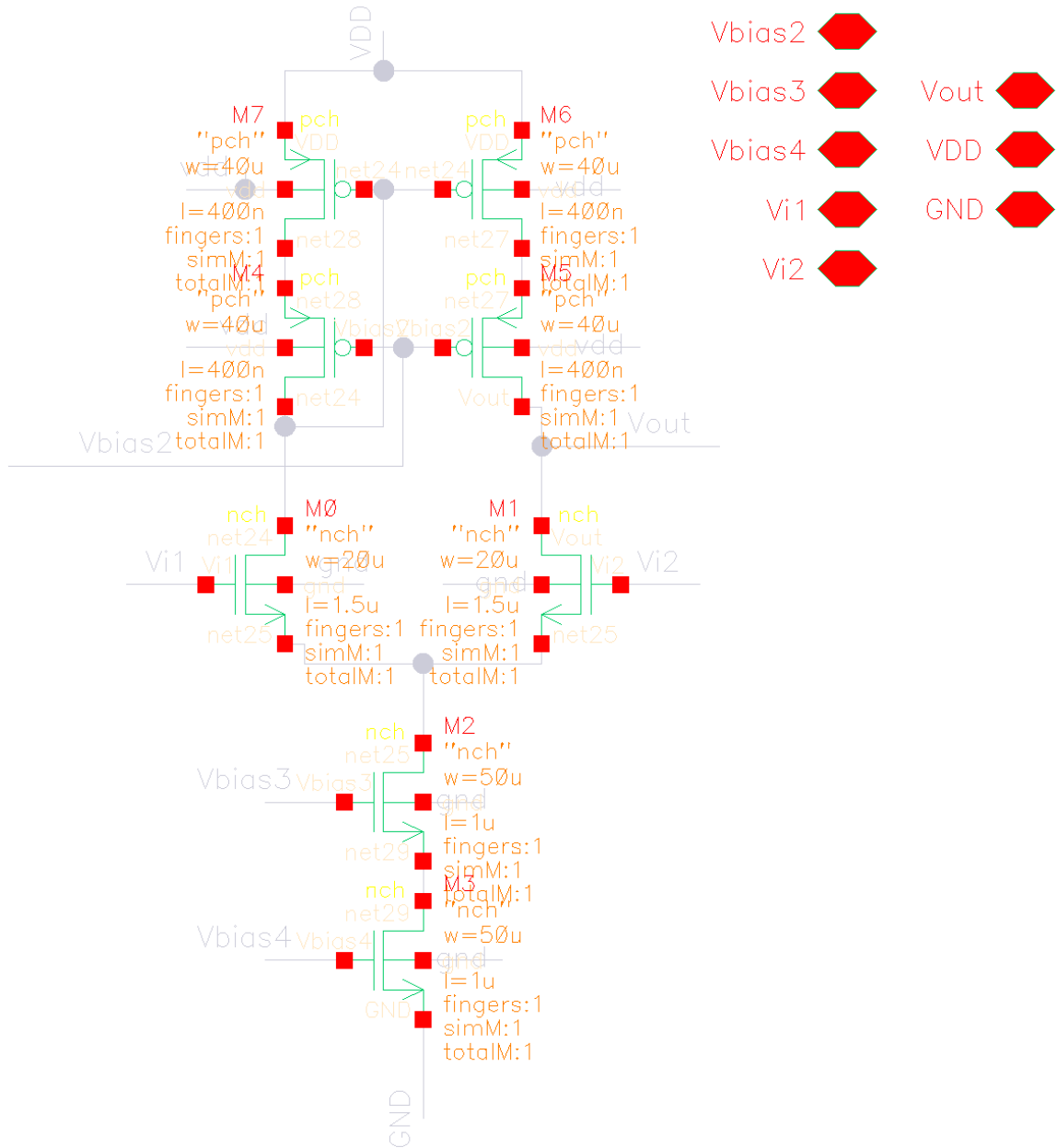
ELEG 587V Project #3 (100 pts)

For both parts, you are to utilize Cadence Virtuoso to design the necessary circuits. You supply voltage should be no larger than 1.2 V, and the circuits should be fully contained (i.e., you only provide the input signals and the power). You will write a short report and turn in all necessary schematics, simulations, and waveforms.

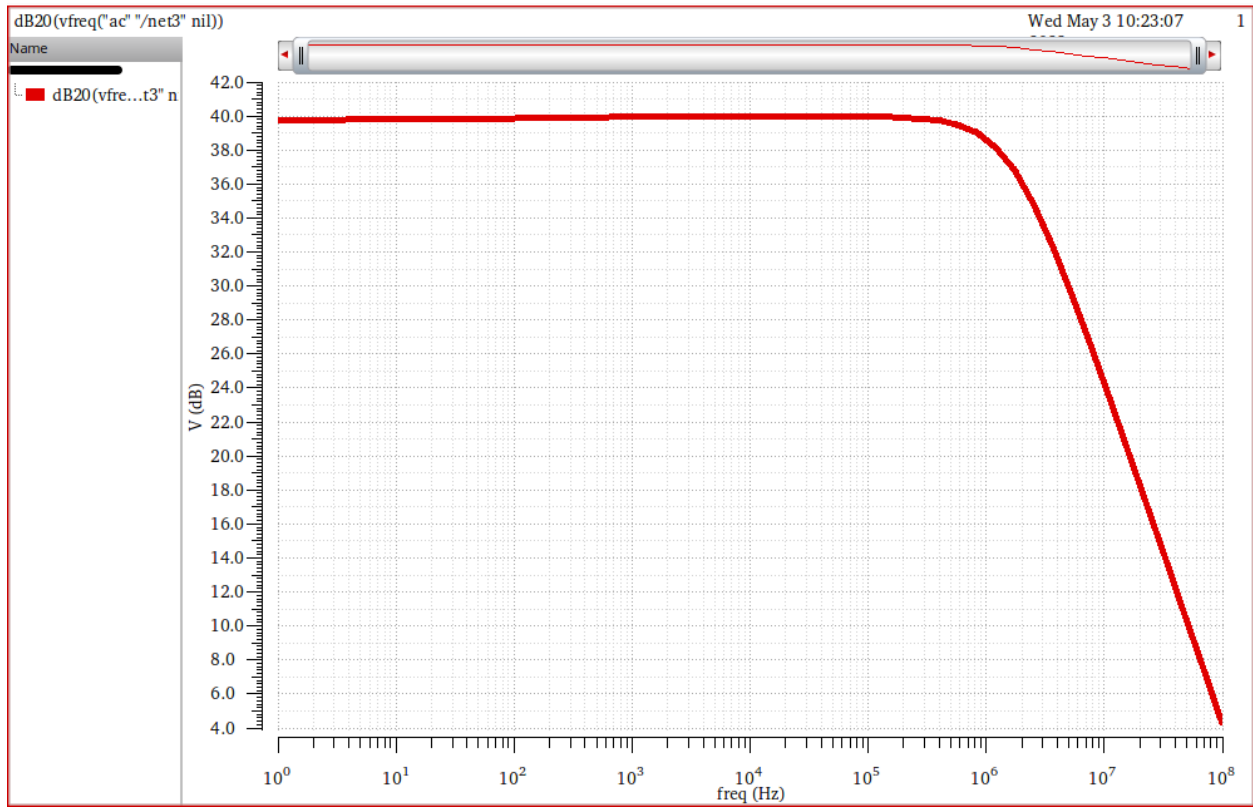
1. Design an instrumentation amplifier that has differential outputs and is capable of amplifying a 1-mV input signal to 500 mV. Provide transient simulations for 5 different voltage levels from 1 mV to 50 mV for a sine wave input. You must also utilize common-mode feedback in at least one of the op amps. Provide the Bode plot for the gain and phase of the instrumentation amplifier.



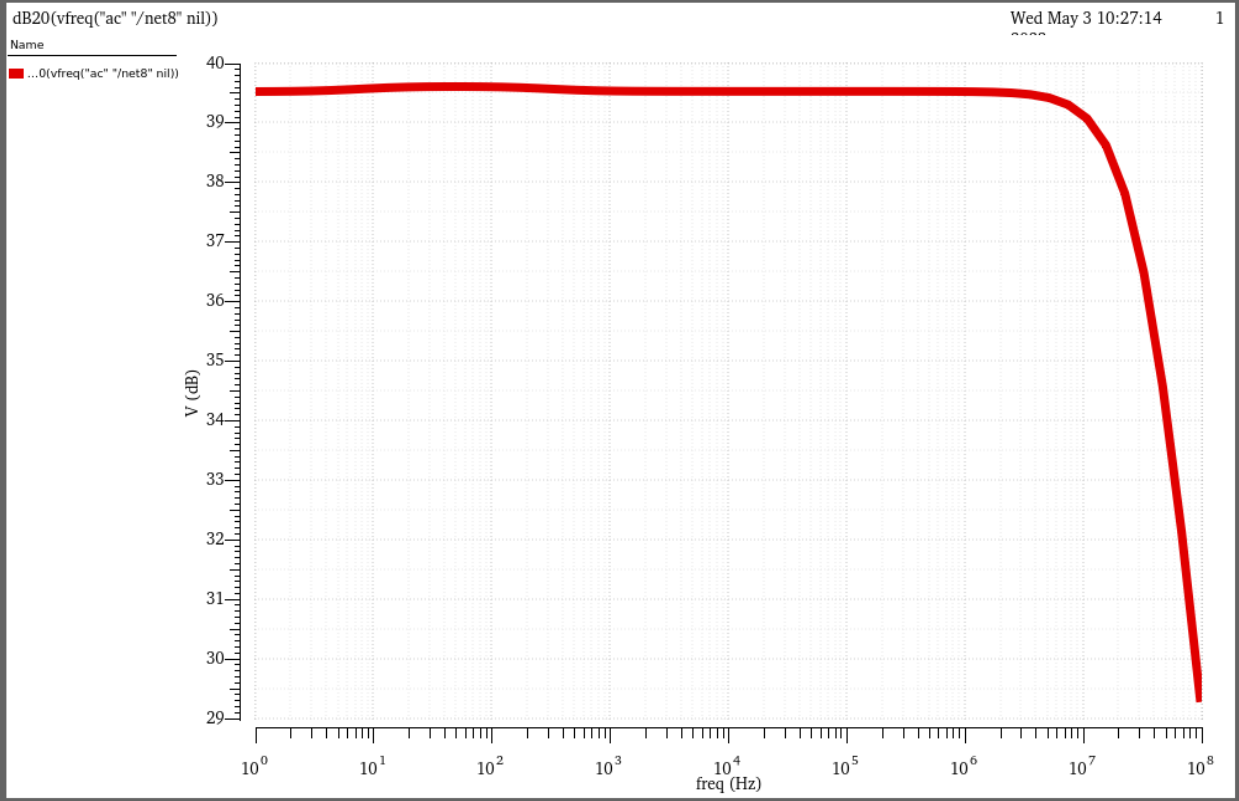
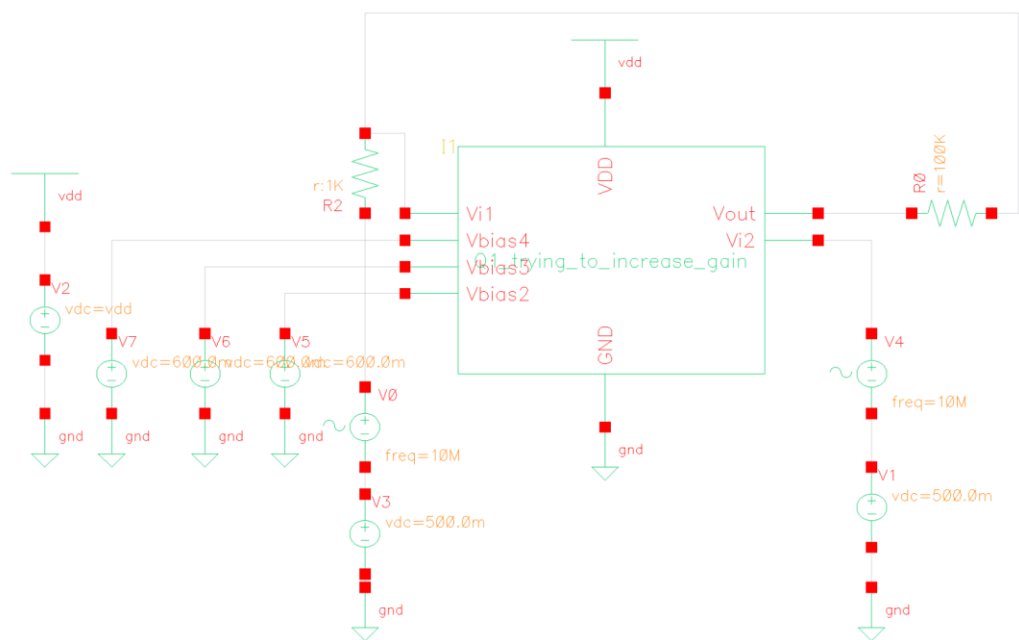
Design of single ended diff amp:



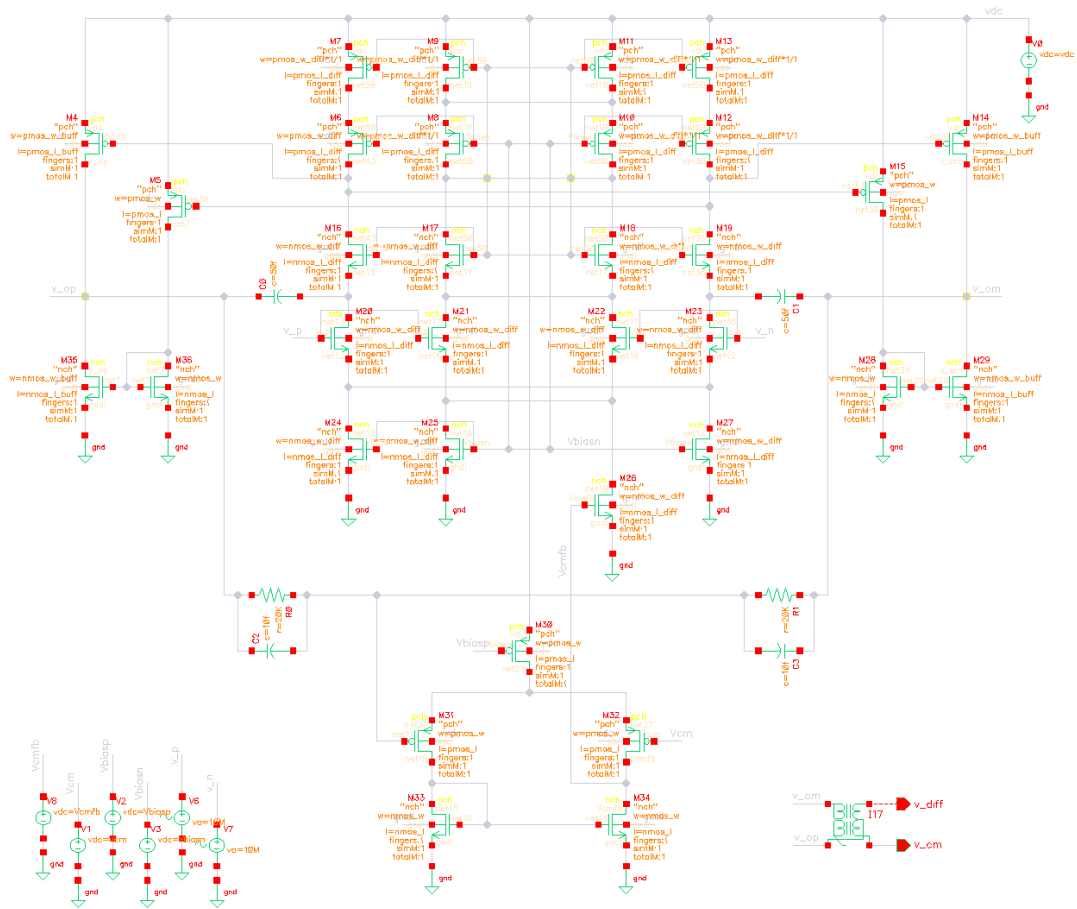
Open-loop response:



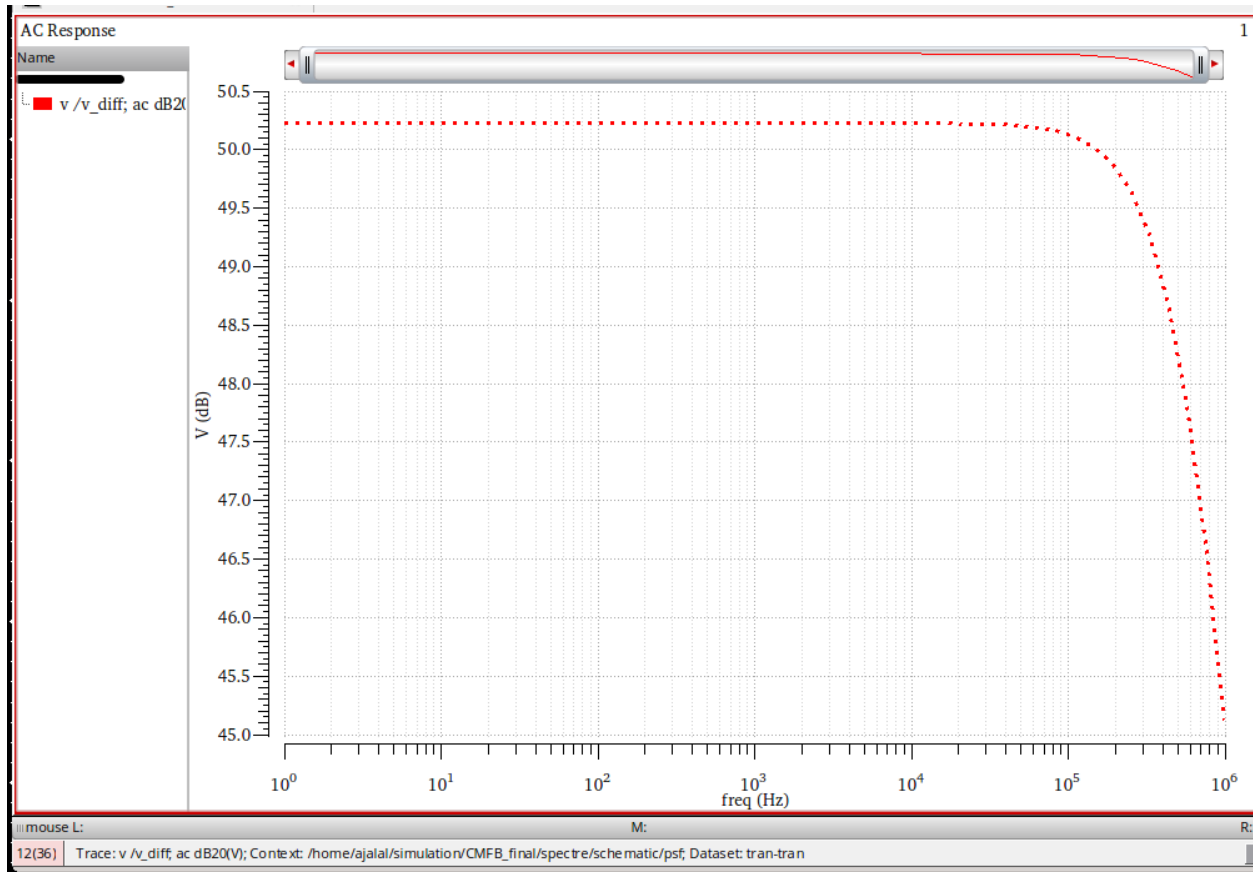
Closed-loop response:



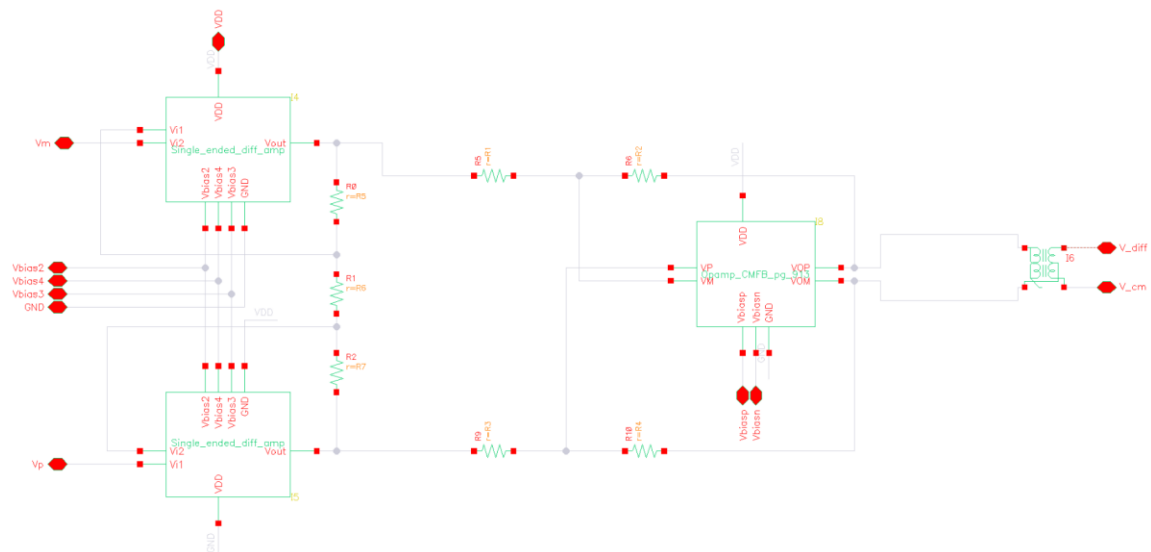
Opamp with CMFB:
Schematic:



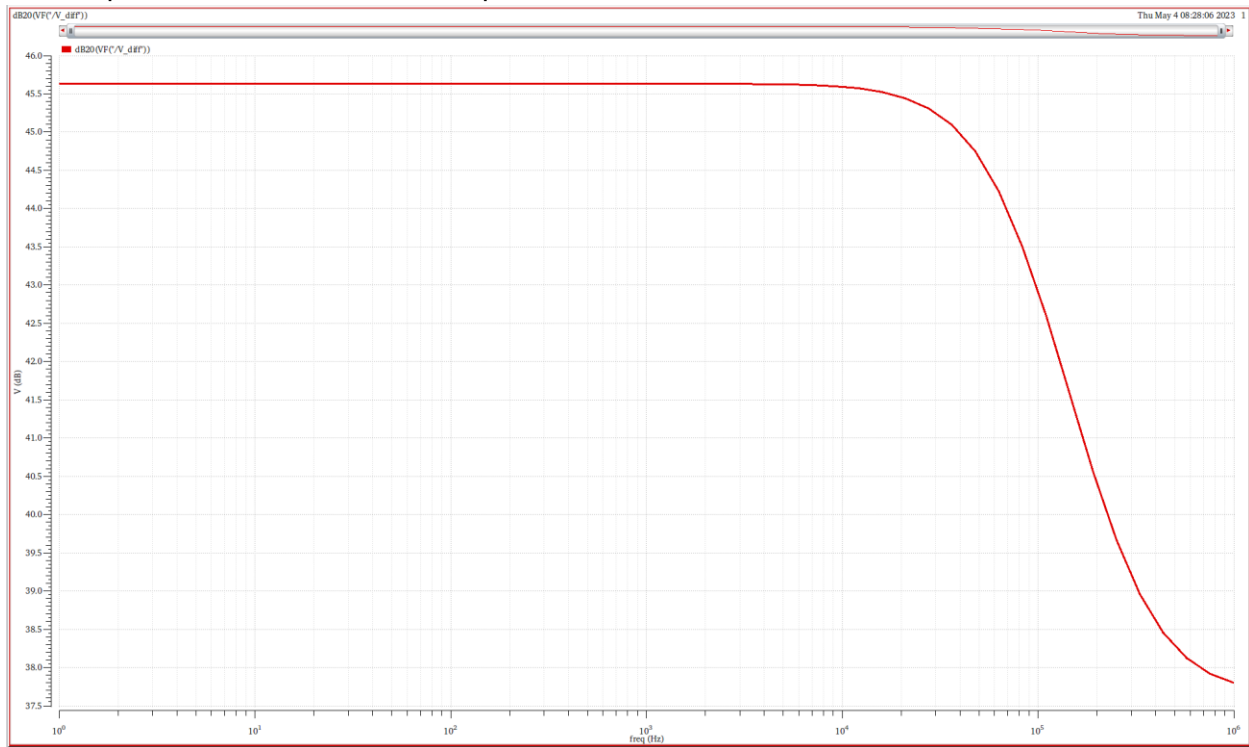
AC Response:



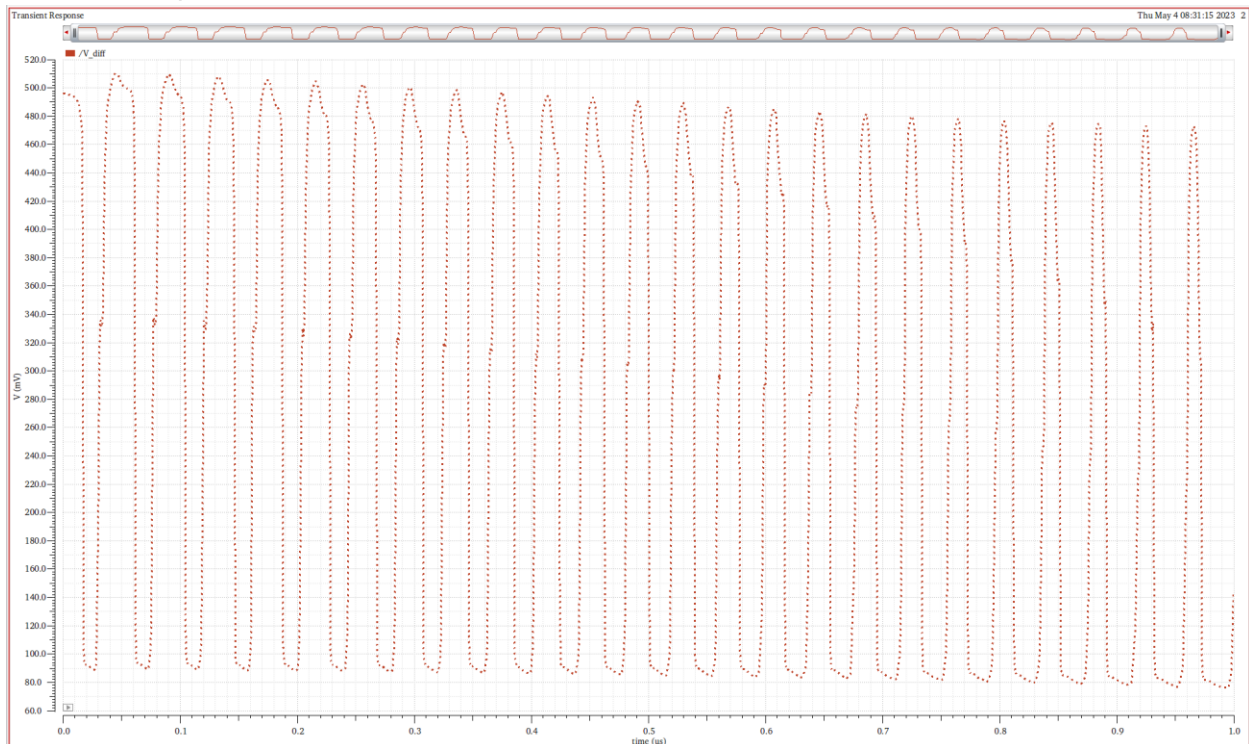
Instrumentation Amplifier Schematic:



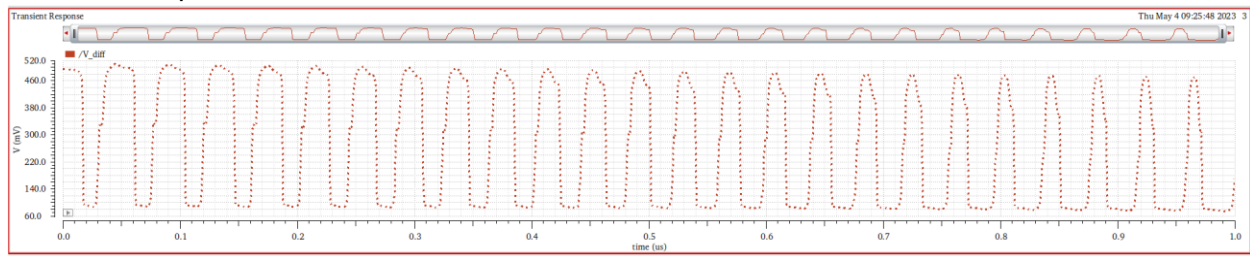
AC Response of Instrumentation Amplifier:



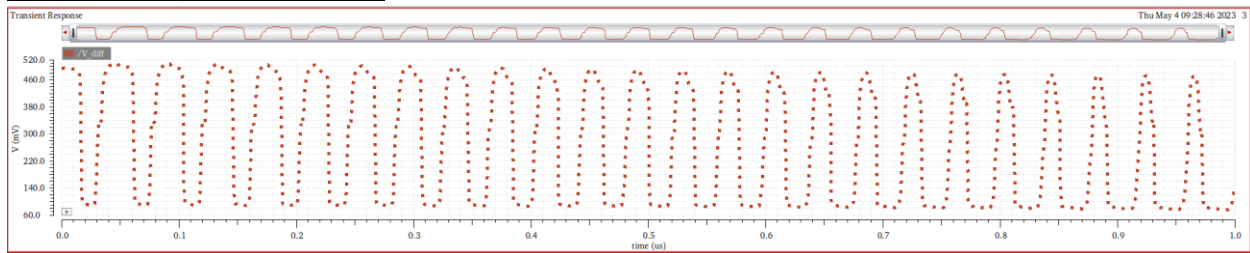
Transient response @ 1mv:



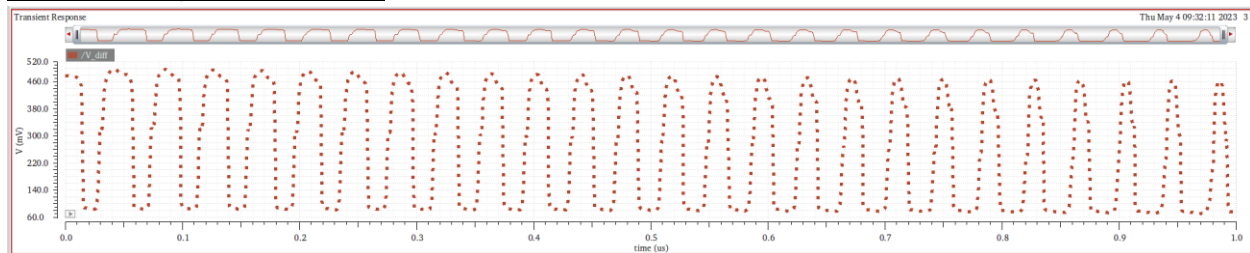
Transient response @ 10mv:



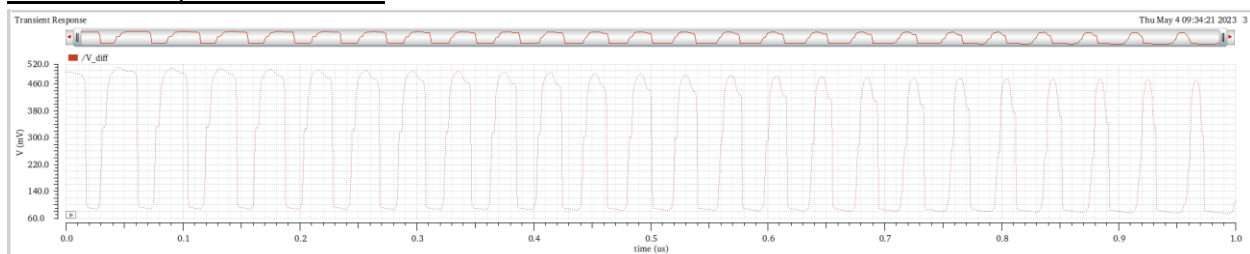
Transient response @ 20mv:



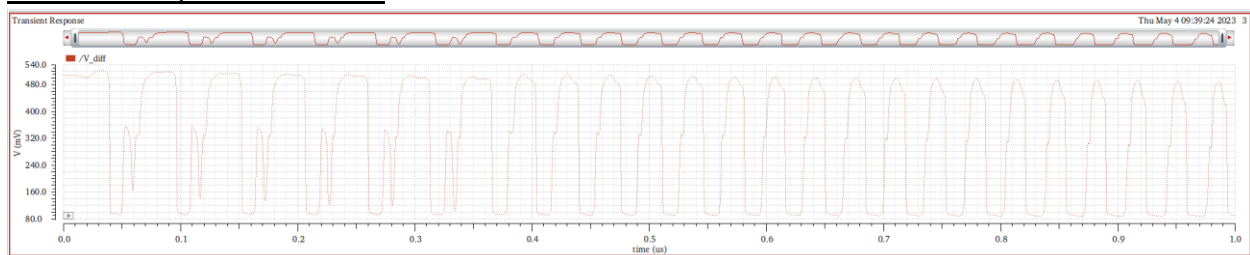
Transient response @ 30mv:



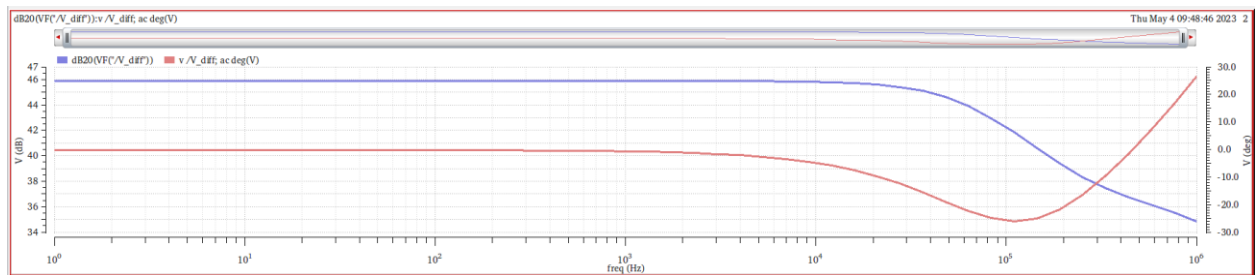
Transient response @ 40mv:



Transient response @ 50mv:

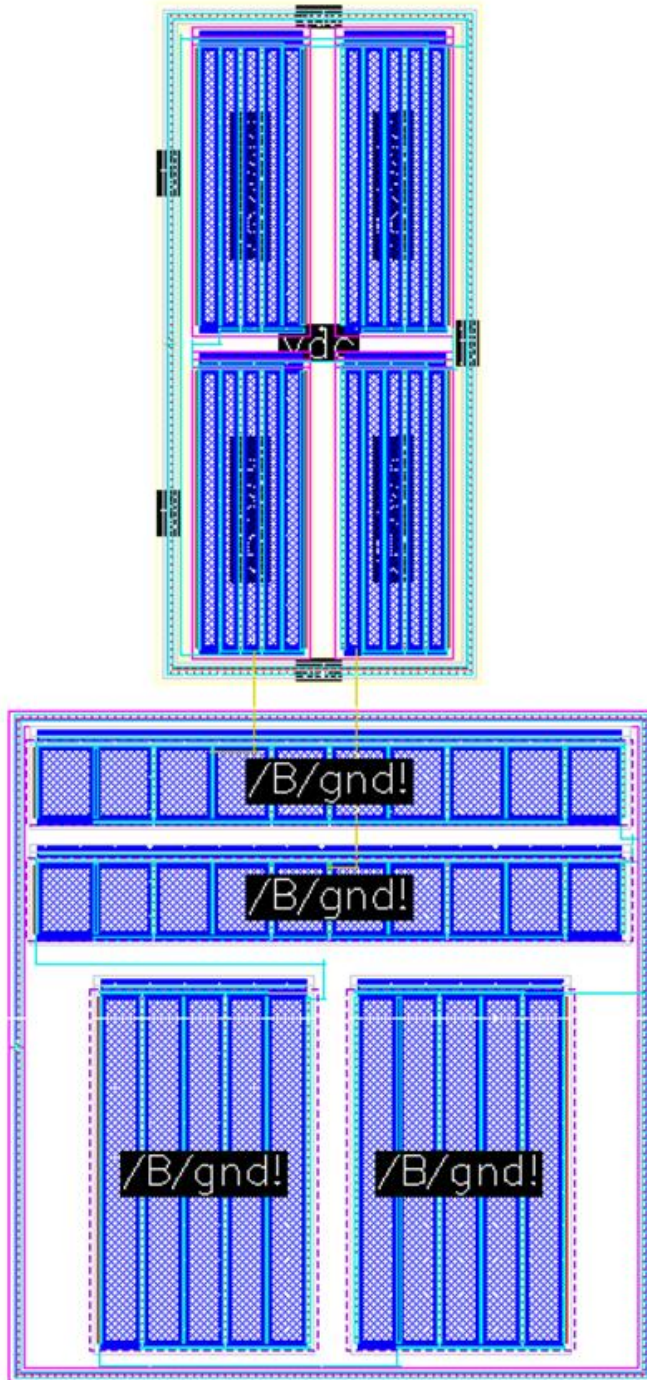


Bode Plot:



2. Layout the instrumentation amplifier so that it is DRC and LVS clean. You must contain the entirety of it within a 250 by 250 μm^2 space. Provide layouts for each individual op amp as well as the overall design.

Single ended op amp layout



LVS and DRC

Cell p3_singend Summary (Clean)

CELL COMPARISON RESULTS (TOP LEVEL)

```

      #
    #
#   #
#   #
#

```

```

#####
#
#   CORRECT   #
#
#####

```

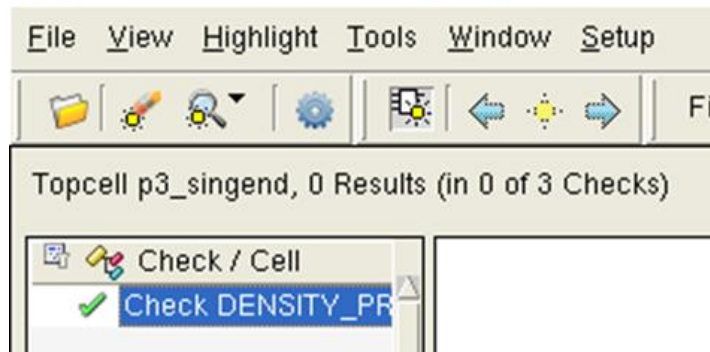
```

- -
* *
|
_ _ _

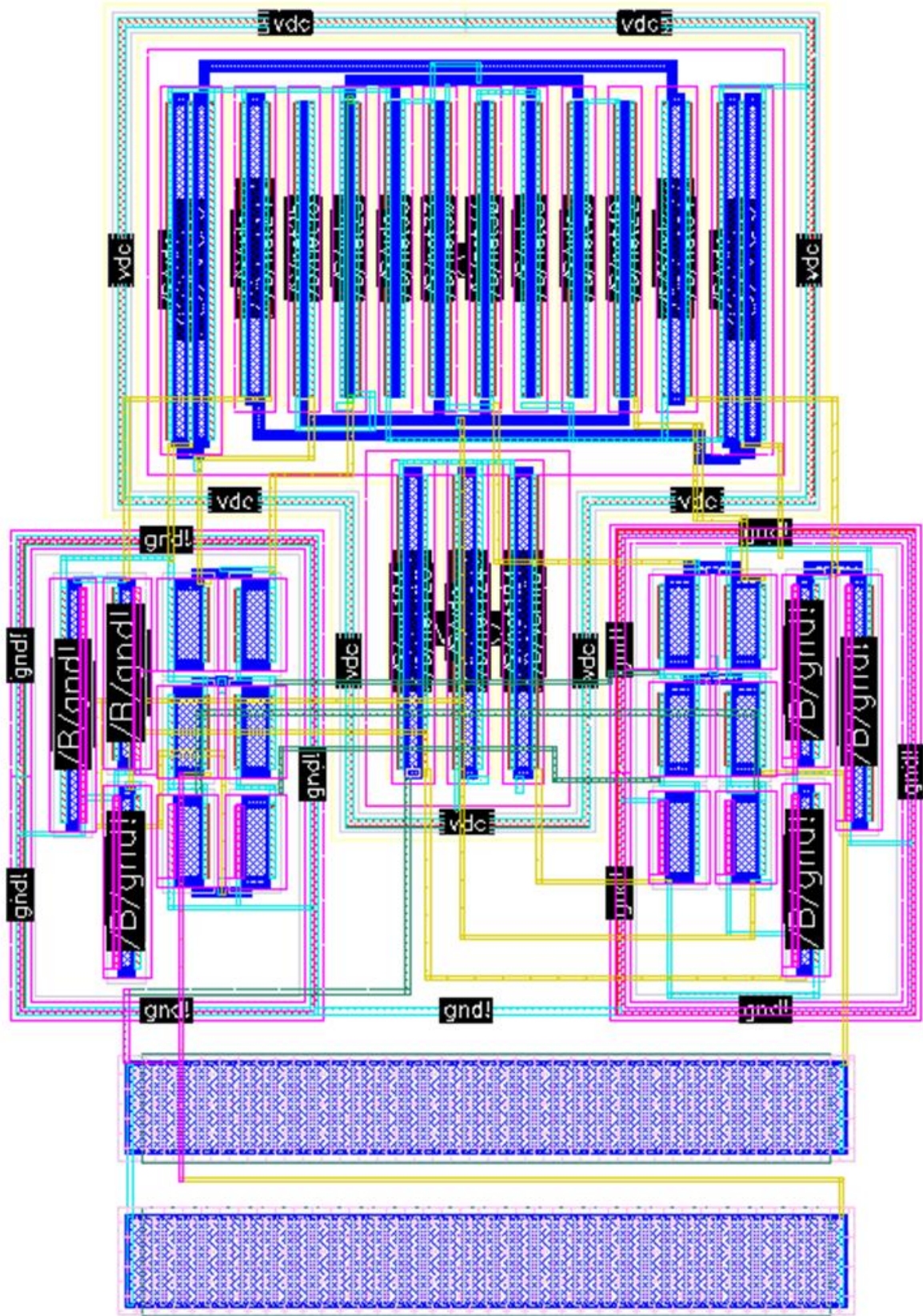
```

```
LAYOUT CELL NAME:      p3_singend
SOURCE CELL NAME:      p3_singend
```

Calibre - RVE v2011.4_35.27: p3_singend.drc.results



Fully differential op amp with common-mode feedback layout



LVS and DRC

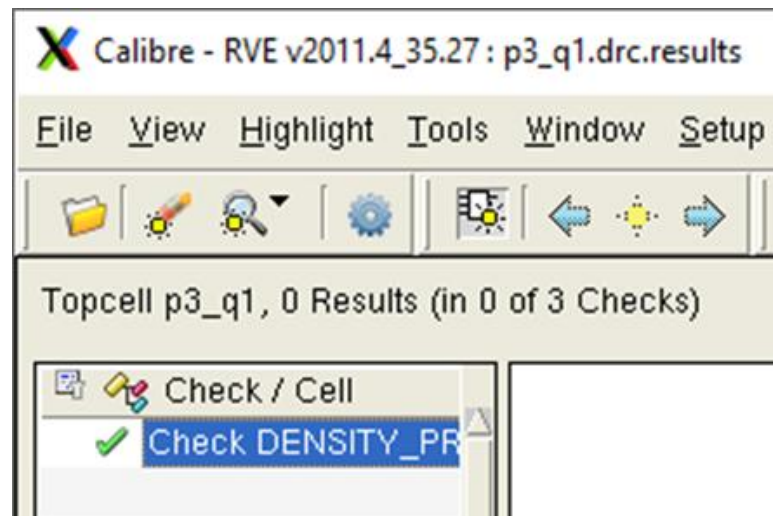
Cell p3_q1 Summary (Clean)

CELL COMPARISON RESULTS (TOP LEVEL)

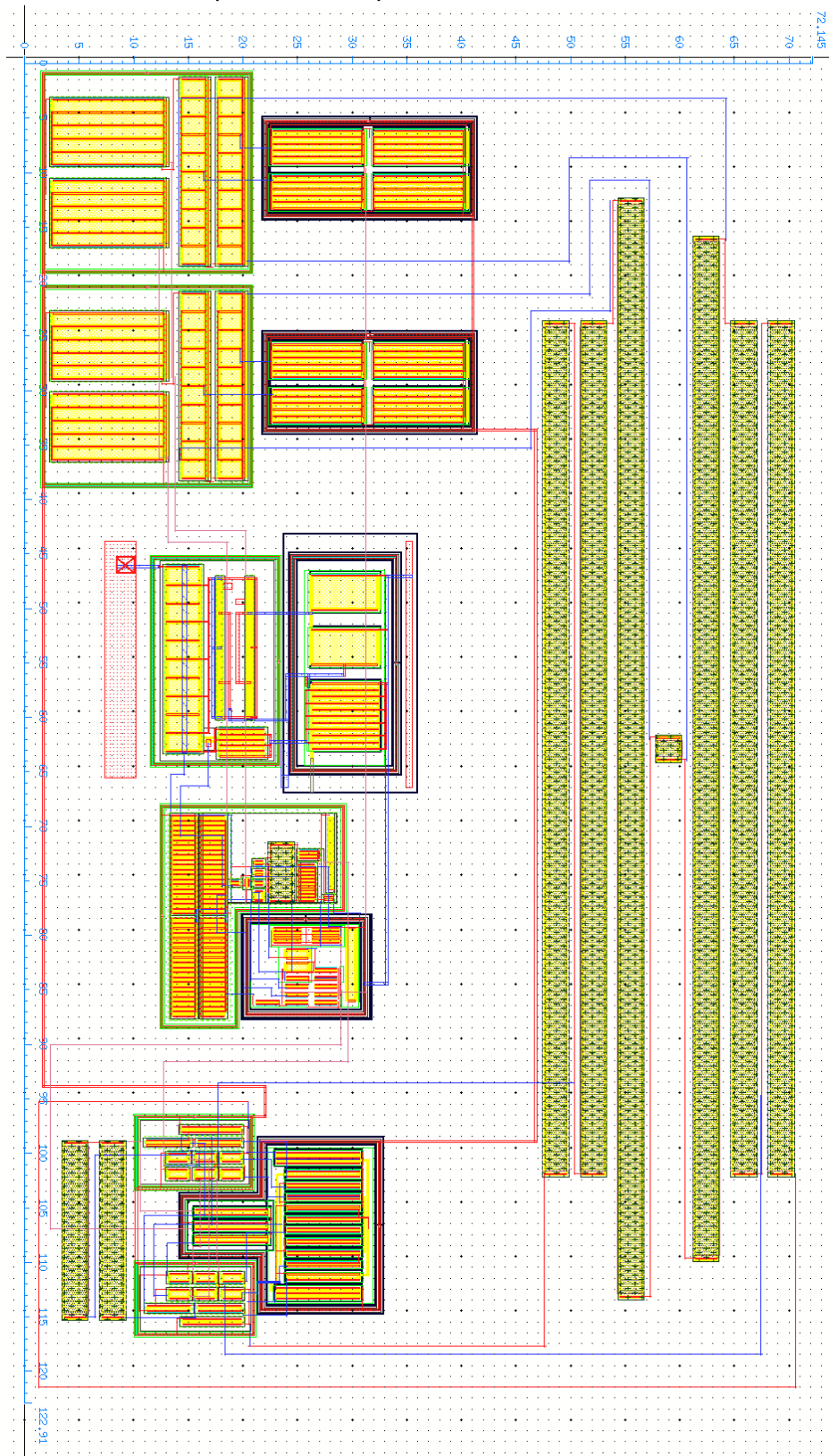
```
      #
      #
#     #
#   #
#
#
#####
#
#   CORRECT   #
#
#
#####
```

```
  - -
  * *
  |
  \_/_
```

LAYOUT CELL NAME: p3_q1
SOURCE CELL NAME: p3_q1



Instrumentation Operational Amplifier



As indicated by the ruler, the dimensions are 122.91um x 72.145um

LVS and DRC

Cell p3_instr Summary (Clean)

CELL COMPARISON RESULTS (TOP LEVEL)

```

      #
      #
#   #
# #
#
#####
#
#   CORRECT   #
#
#####

```

```
LAYOUT CELL NAME:      p3_instr
SOURCE CELL NAME:      p3_instr
```

Calibre - RVE v2011.4_35.27 : p3_instr.drc.results

File View Highlight Tools Window Setup



Topcell p3_instr, 0 Results (in 0 of 3 Checks)

Check / Cell

Check DENSITY_PR