

**EXP-2**  
**VLSI ENGINEERING**  
**ANALOG**  
**DIFFERENTIAL- AMPLIFIRE**

**SWAGATA NASKAR**  
**19EC30047**

## DIFFERENTIAL AMPLIFIER :

### Aim:

To design Differential amplifier for multiple configurations

### Design steps:

#### Step 1:

Assume some specifications such as the Gain Bandwidth, Slew-rate, Load Capacitance, ICMR range etc. for designing the differential amplifier accordingly.

#### Step 2:

Determine the technology-dependent parameters like VDD, threshold voltage of pMOS and nMOS ( $V_{tp}$  and  $V_{tn}$ ),  $\mu_n C_{ox}$ ,  $\mu_p C_{ox}$  etc. from the model files in the circuit simulation tool used. Using the standard equations, determine the value of drain current.

#### Step 3:

Find (w/L) ratio of the top 2 transistors using the above assumed ICMR (max) value, (w/L) ratio of the middle 2 transistors (M3 & M4) using the assumed Gain Bandwidth product value, and (w/L) ratio of the bottom 2 transistors using the assumed ICMR (min) value.

#### Step 4:

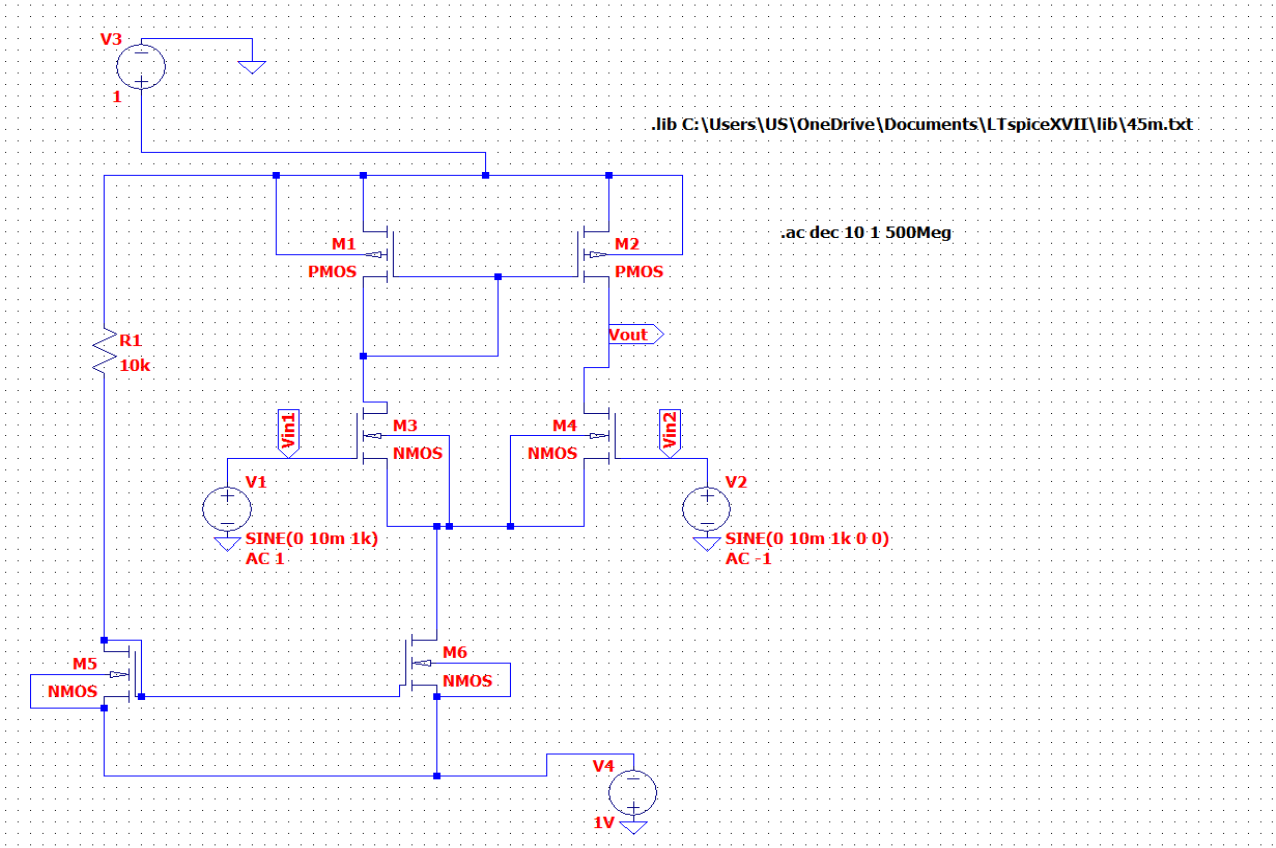
Finally, test the circuit with the above determined values in a circuit simulation tool such as Cadence or ADS etc. & determine the values of the parameters you assumed in Step 1 from the tool.

#### Step 5:

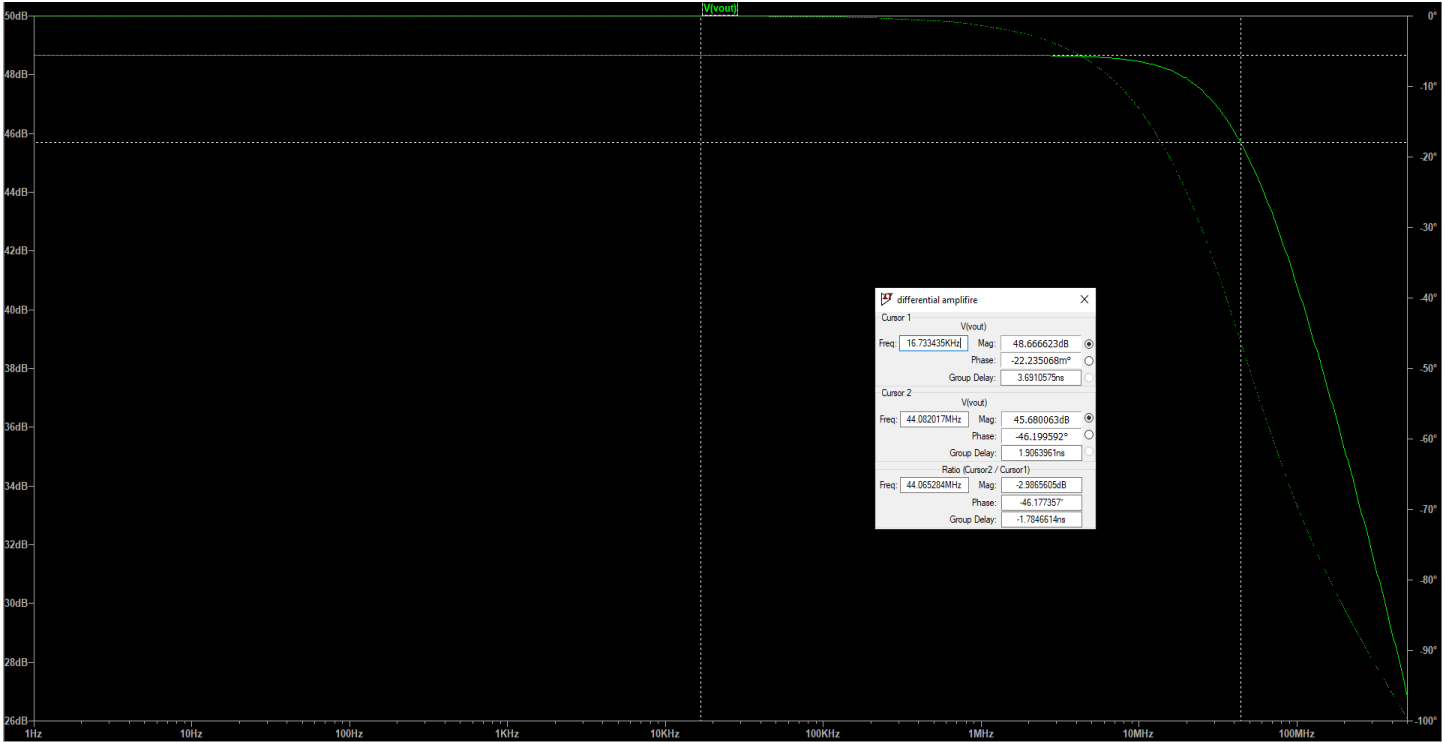
If they come out to be approximately equal to that you assumed, you are done! (but you can still improve the circuit if you want).

If they do not come out to be what you assumed, check your calculations, values of technology-dependent tool parameters & the values you entered in the circuit simulation tool.

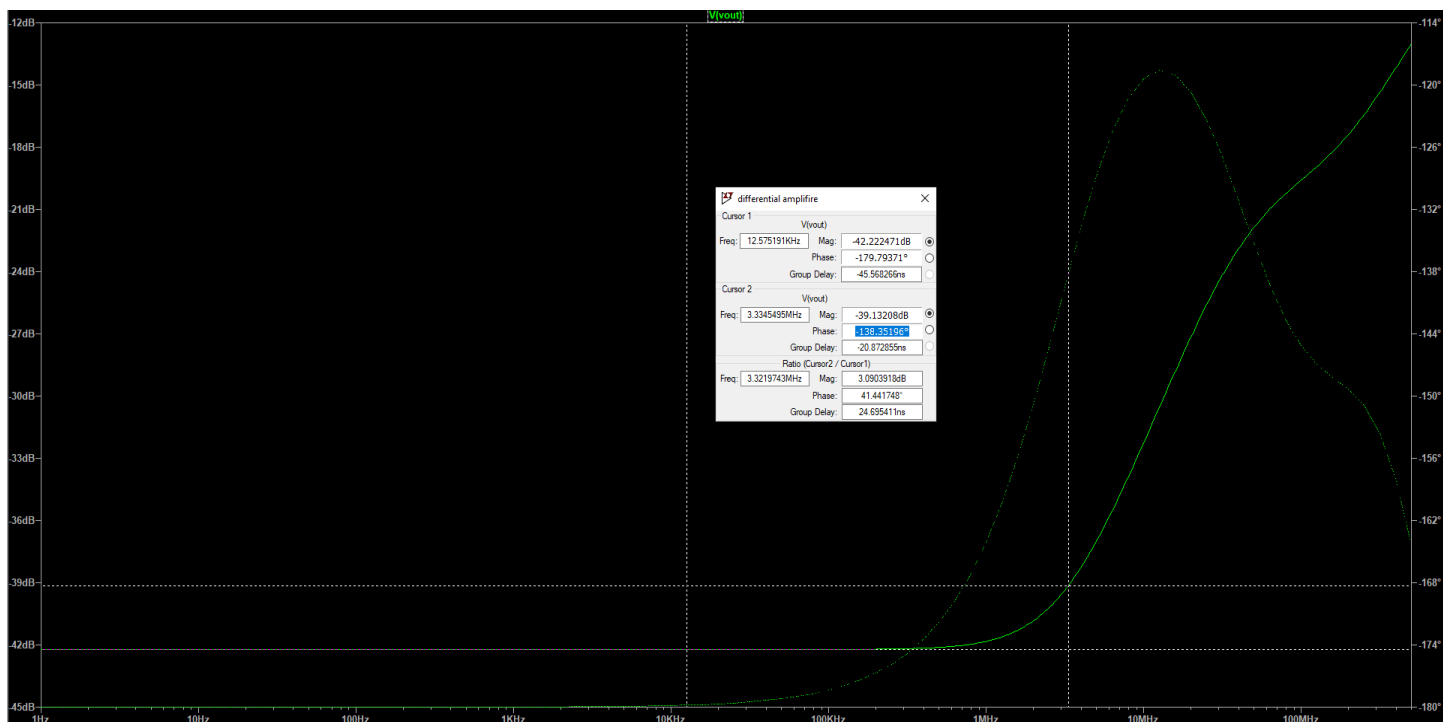
Circuit Diagram :



Observation:  
Ad plot

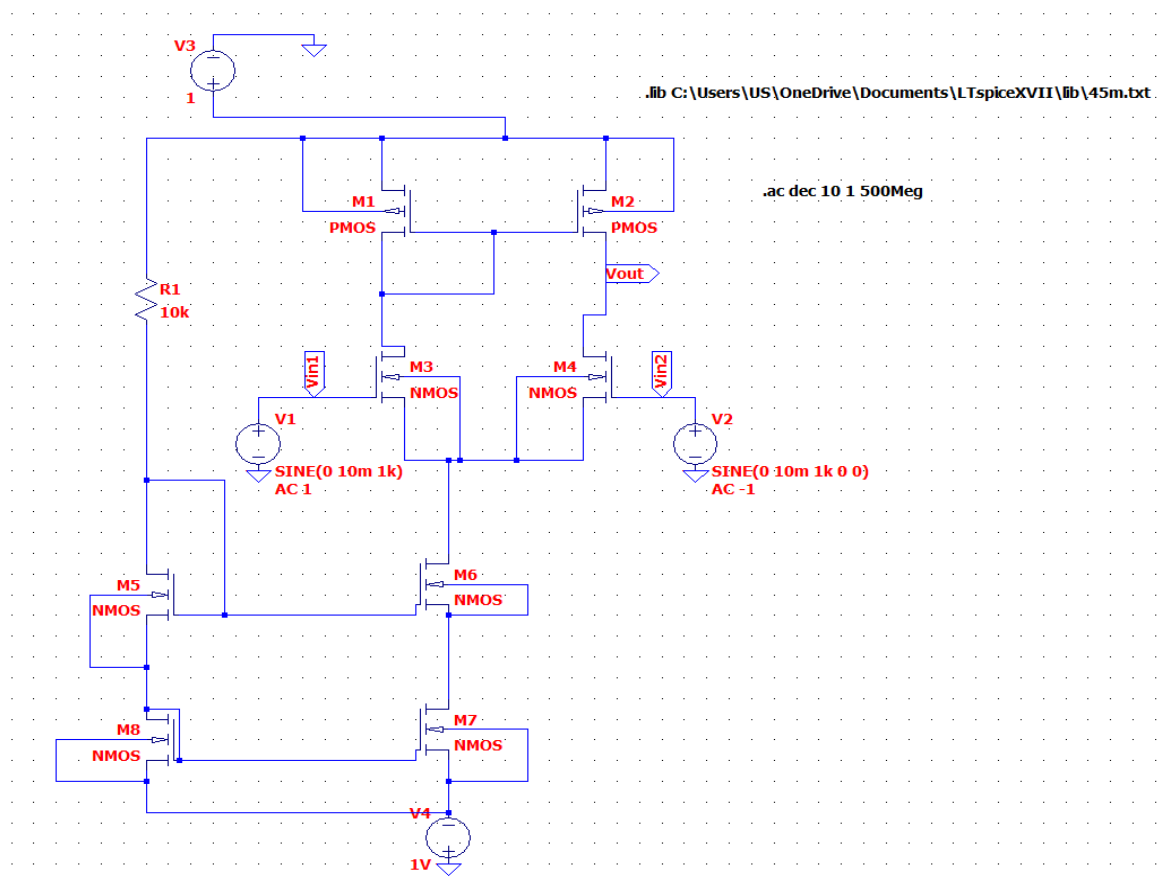


## Ac plot

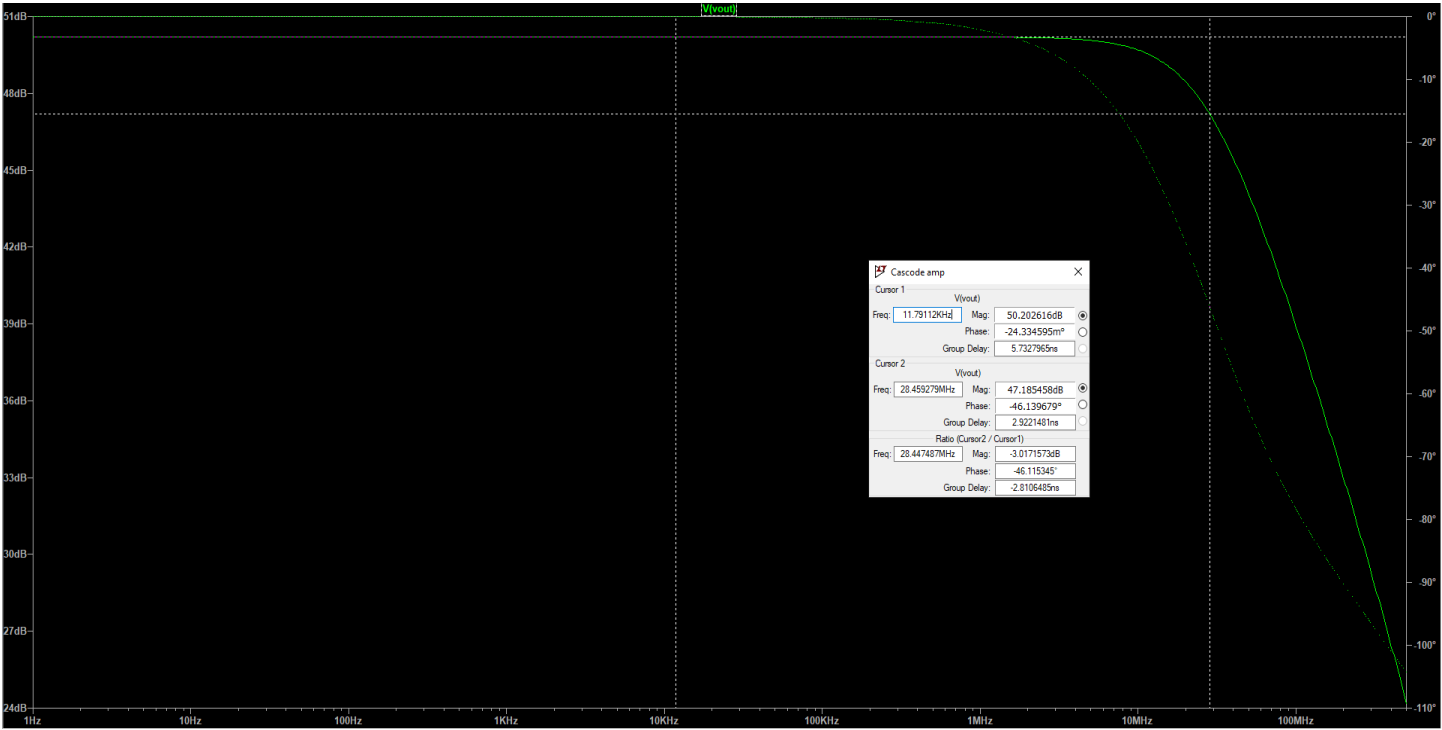


## CASCODE- AMPLIFIER

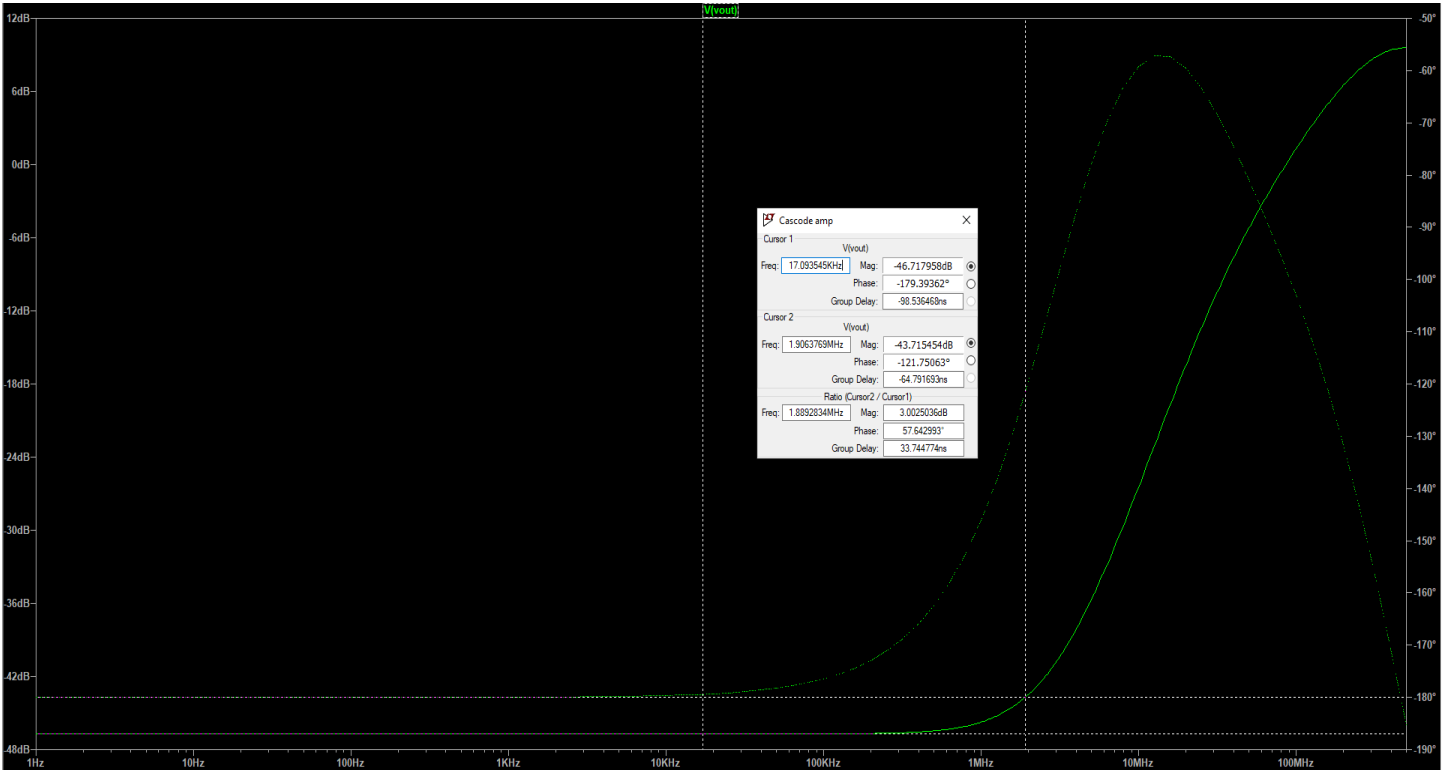
### Circuit Design :



Ad plot

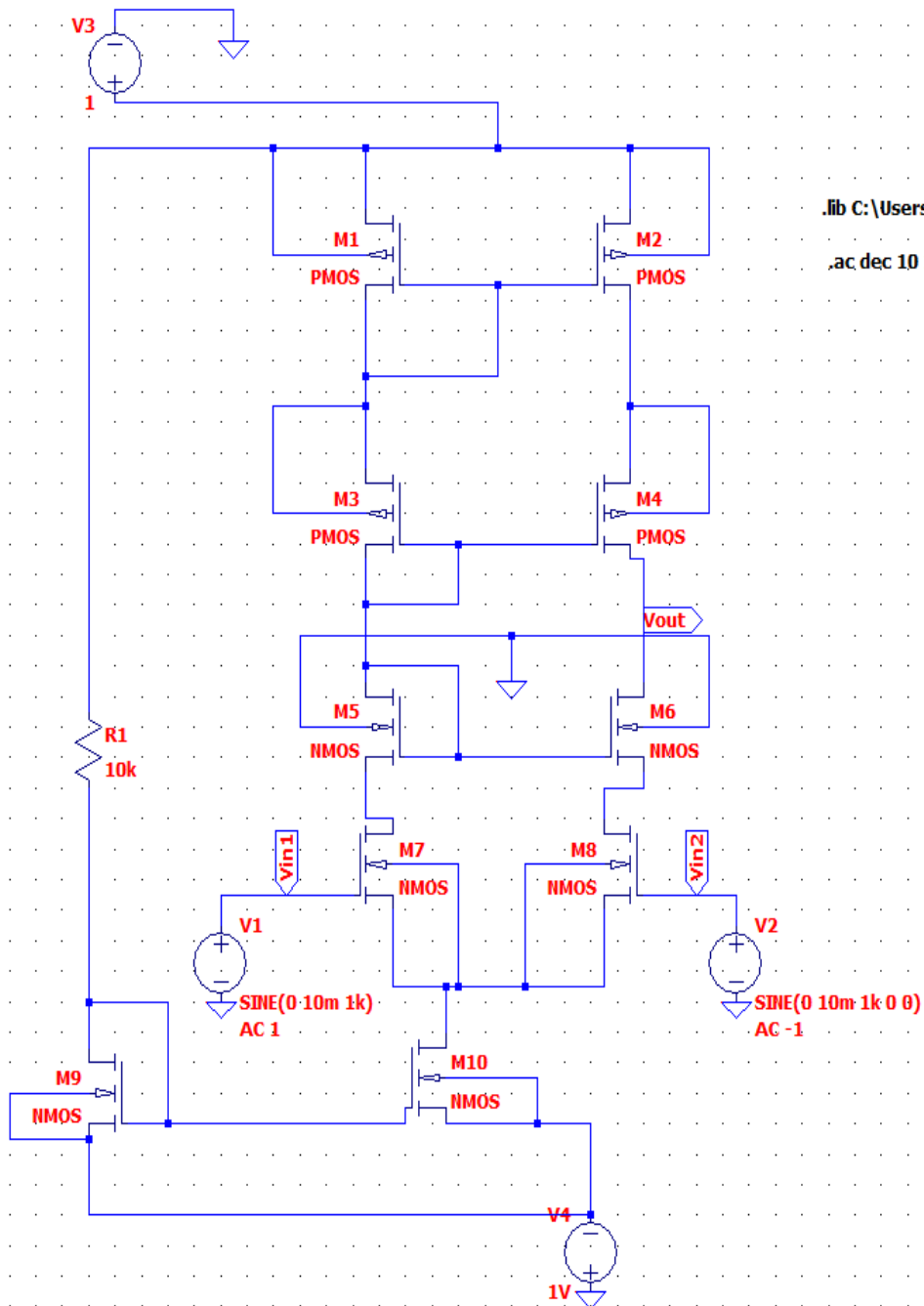


Ac plot



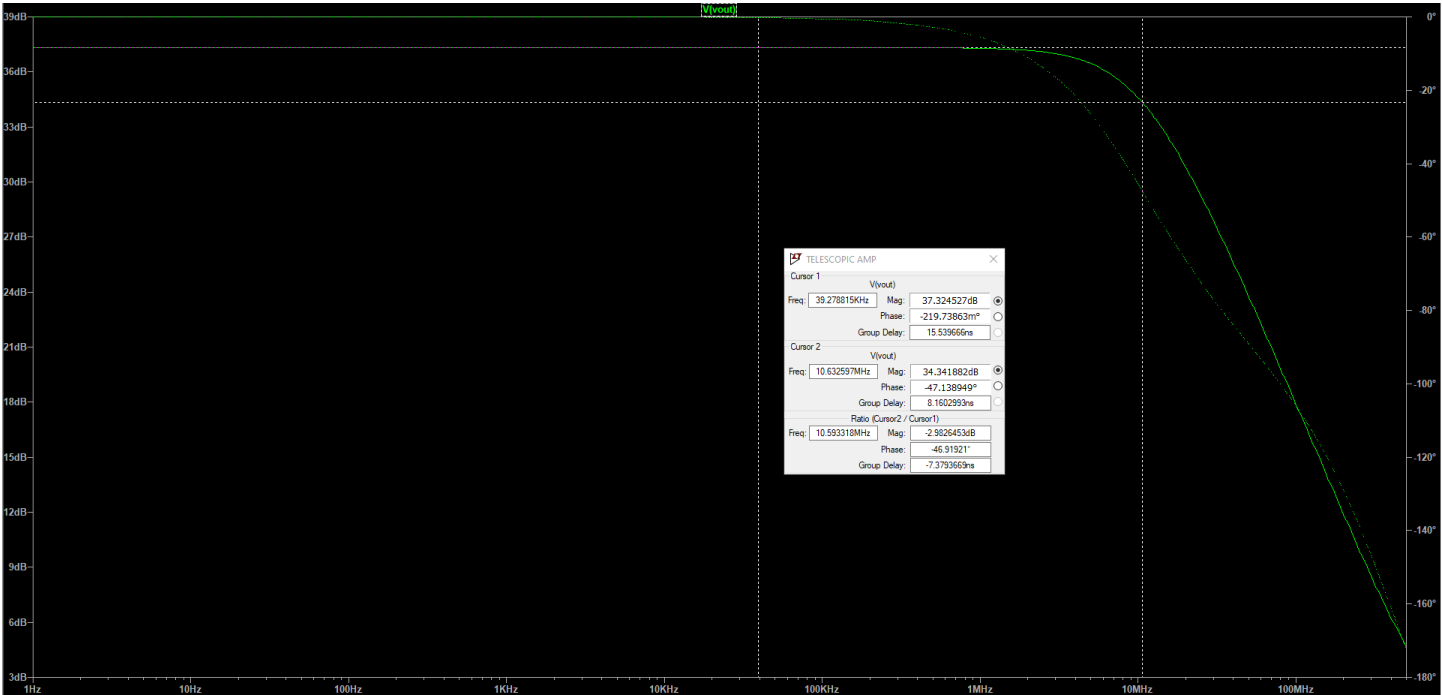
## TELESCOPIC- AMPLIFIER

## Circuit Design:



```
.lib C:\Users\US\OneDrive\Documents\LTspiceXVII\lib\45m.txt
.ac dec 10 1 500Meg
```

Ad Plot



Ac plot

