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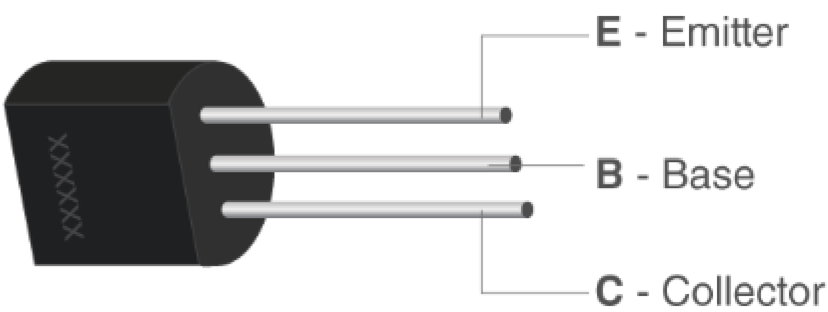
1. **Aim of the experiment:** Studies on small-signal CE amplifier

2. **Tools used:** Resistors, Capacitors, NPN Transistor, Voltage Source.

3. **Background knowledge (brief):**

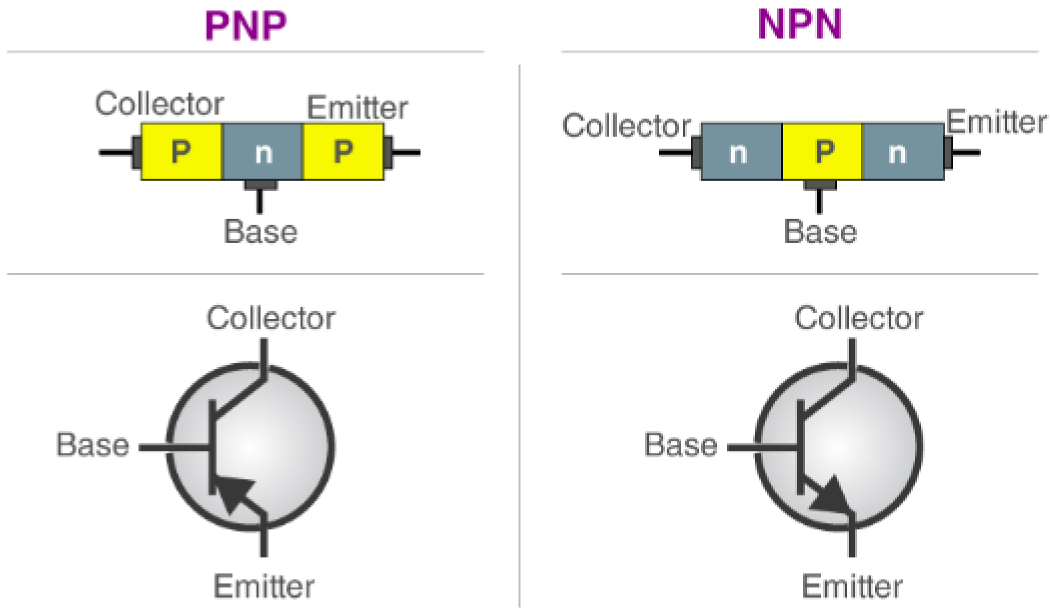
A transistor is a type of semiconductor device that can be used to both conduct and insulate electric current or voltage. A transistor acts as a switch and an amplifier. There are three terminals for a transistor. They are:

- Base
- Collector
- Emitter

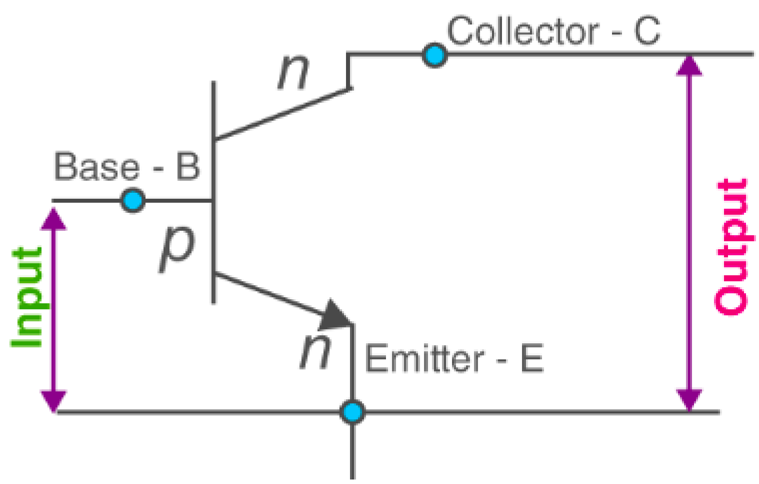


P-N-P Transistor: It is a type of BJT where one n-type material is introduced or placed between two p-type materials

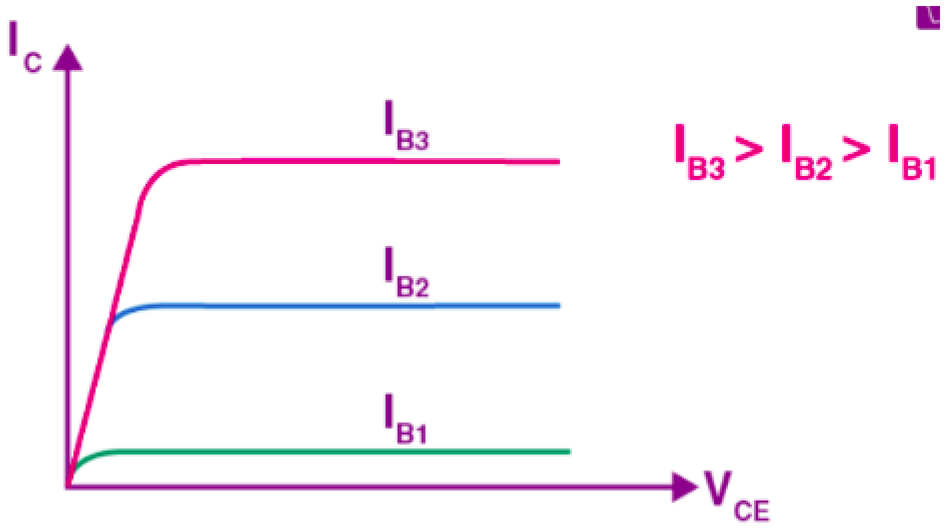
N-P-N Transistor: In this transistor, we will find one p-type material between two n-type materials.



In Common Emitter (CE) configuration, the emitter terminal is shared between the input and the output terminals.

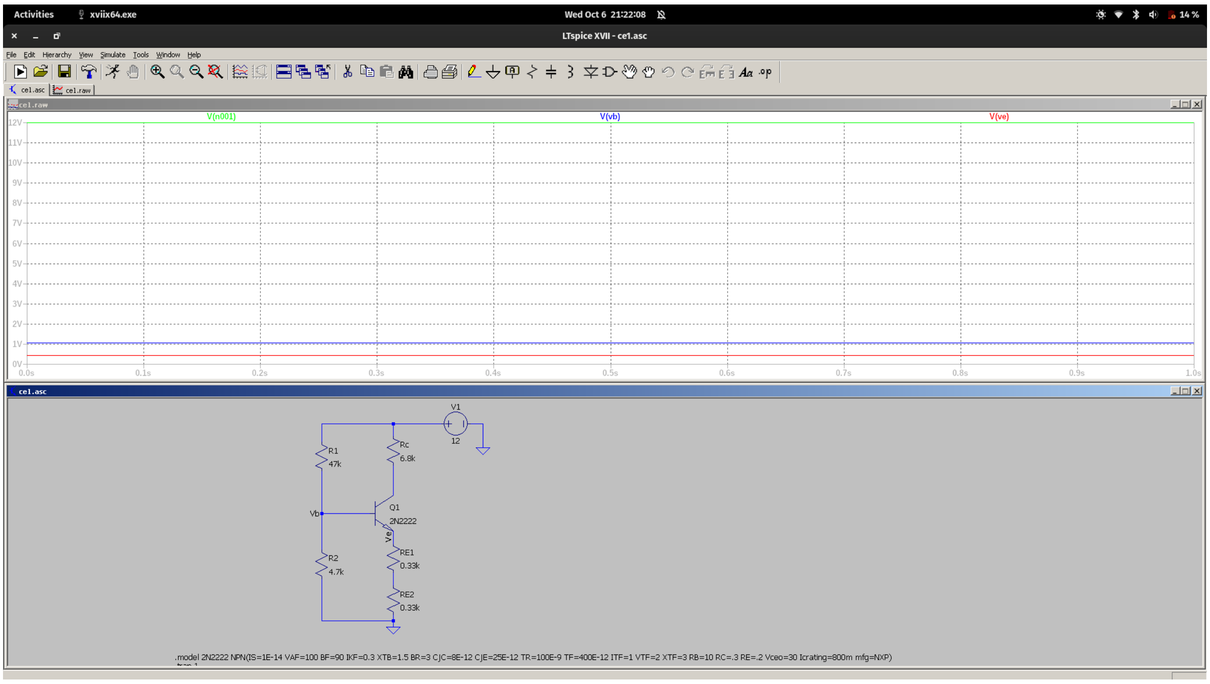


Output Characteristics of a CE Amplifier



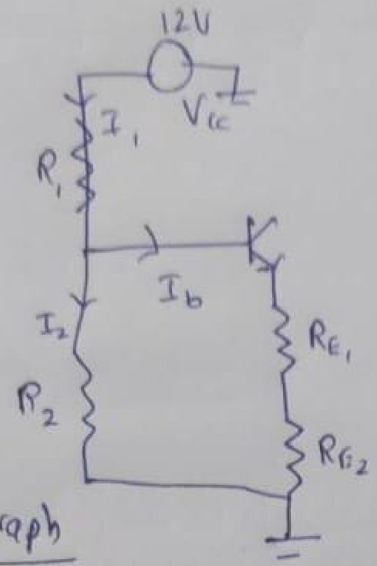
4. Circuit (hand drawn/image):

Measurement of DC conditions



Vb = 1.0627V , Vc = 12V , Ve = 420.955mV

Measurement of DC conditions:-



from graph

$V_b = 1.0627\,V$

$V_e = 420.955\,mV$

$V_{be} = V_b - V_e = 0.641V$

$V_{ce} = V_c - V_e = 11.579V$

$12 - I_1 R_1 = V_B$

$$I_1 = \frac{12 - 1.0627}{47000}$$

$$\boxed{I_1 = 0.2327\,mA}$$

$I_1 = I_2 + I_b$

$V_B = I_2 R_2$

$$I_2 = \frac{1.0627}{4700} = 0.2261\,mA$$

$V_E - I_E(R_{e_1} + R_{e_2}) = 0$

$$I_E = \frac{420.955 \times 10^{-3}}{0.66 \times 1000}$$

$= 0.6378\,mA$

$I_b = I_1 - I_2 = -0.0066\,mA$

$I_e = I_c + I_b$

$I_c = I_e - I_b = 0.6378 + 0.0066$

$= 0.6444\,mA$

From Calculations,

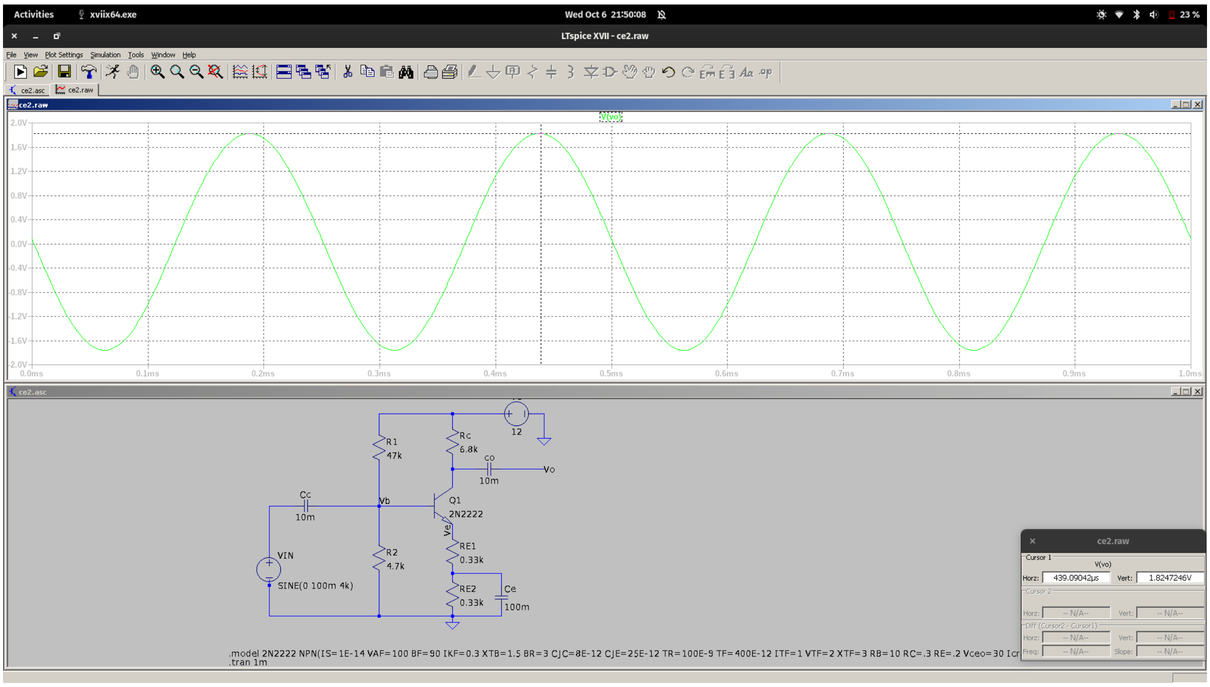
Vbe = 0.641745V , Vce = 11.579V , Ic = 0.6444mA , Ie = 0.6378mA

Signal Handling Capacity

F = 4KHz

1)Without Load Resistance -

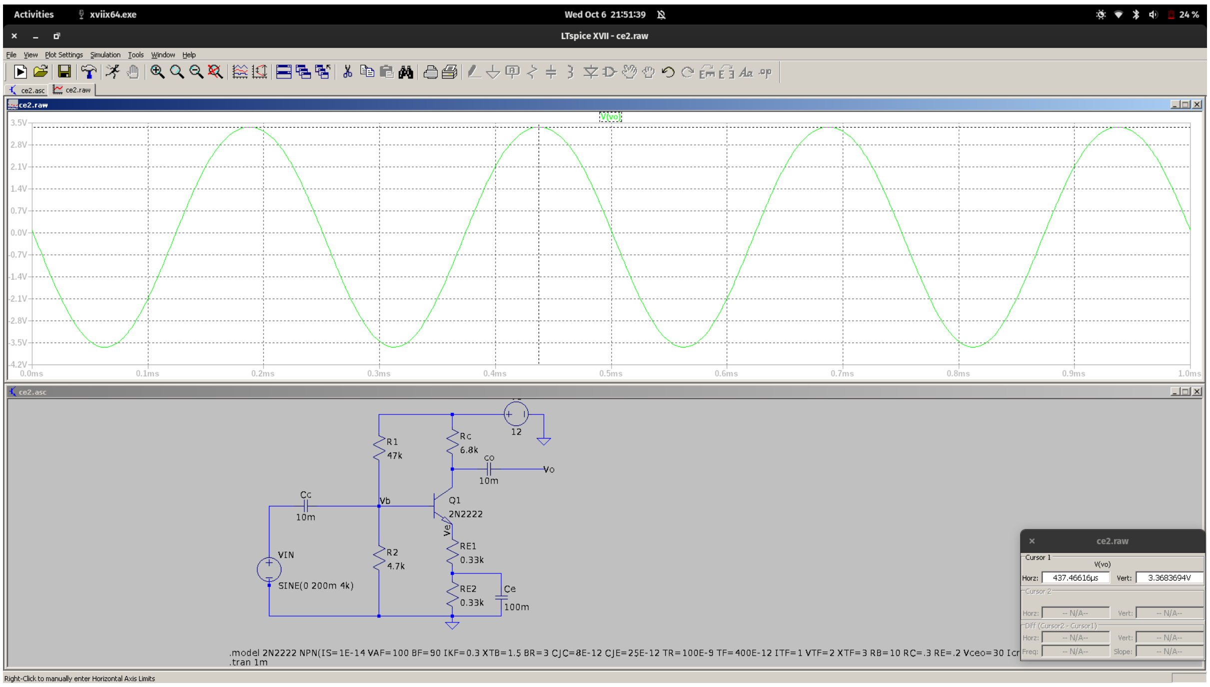
a)Vin = 0.1V



Vo = 1.8247V

Gain A = Vo/Vi = 18.247

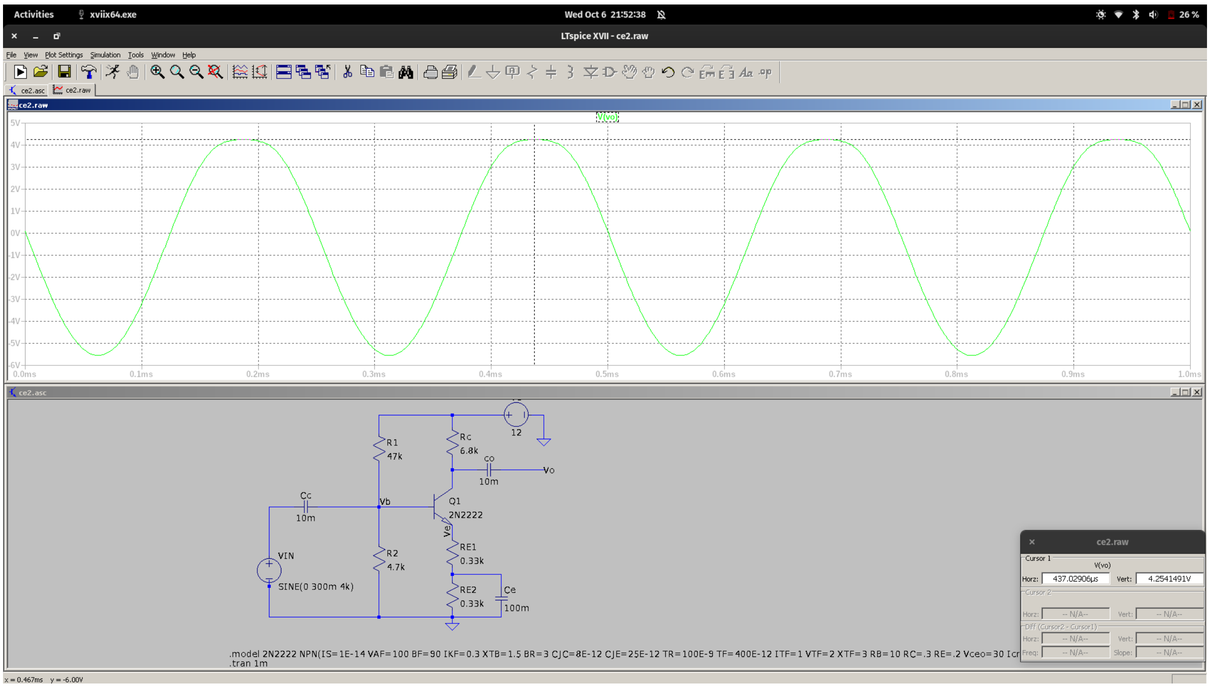
b)Vin = 0.2V



Vo = 3.368V

Gain A = Vo/Vi = 16.84

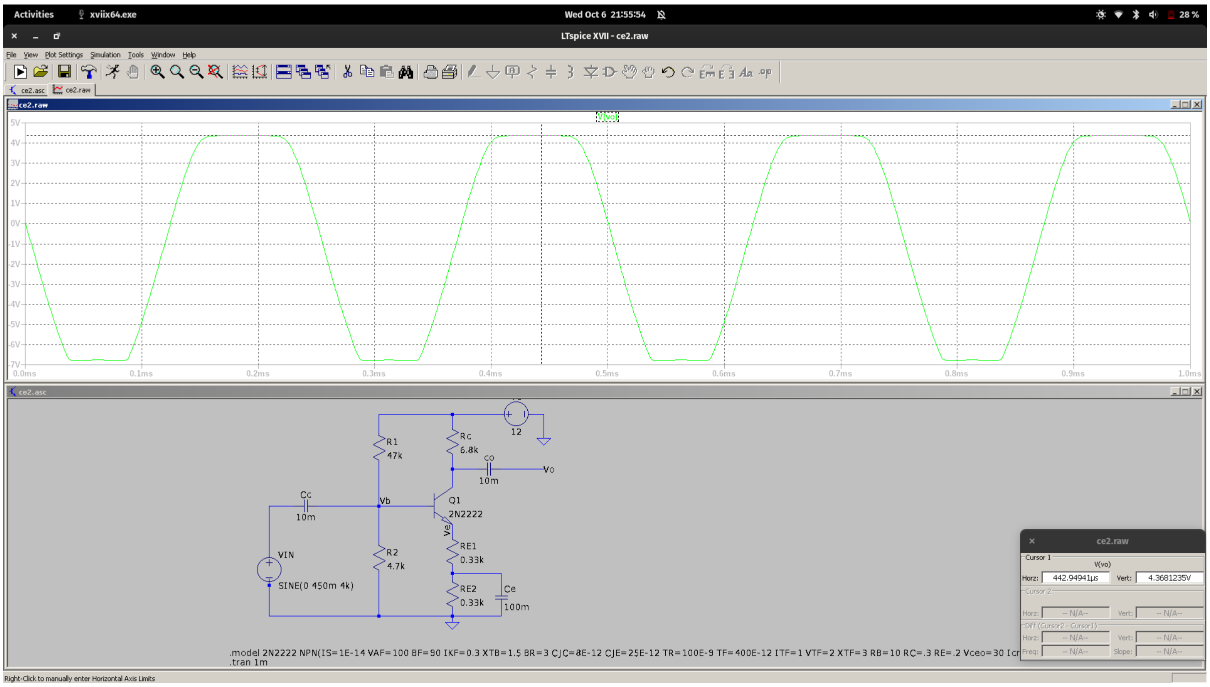
c)Vin = 0.3V



Vo = 4.2541V

Gain A = Vo/Vi = 14.18

d)Vin = 0.45V



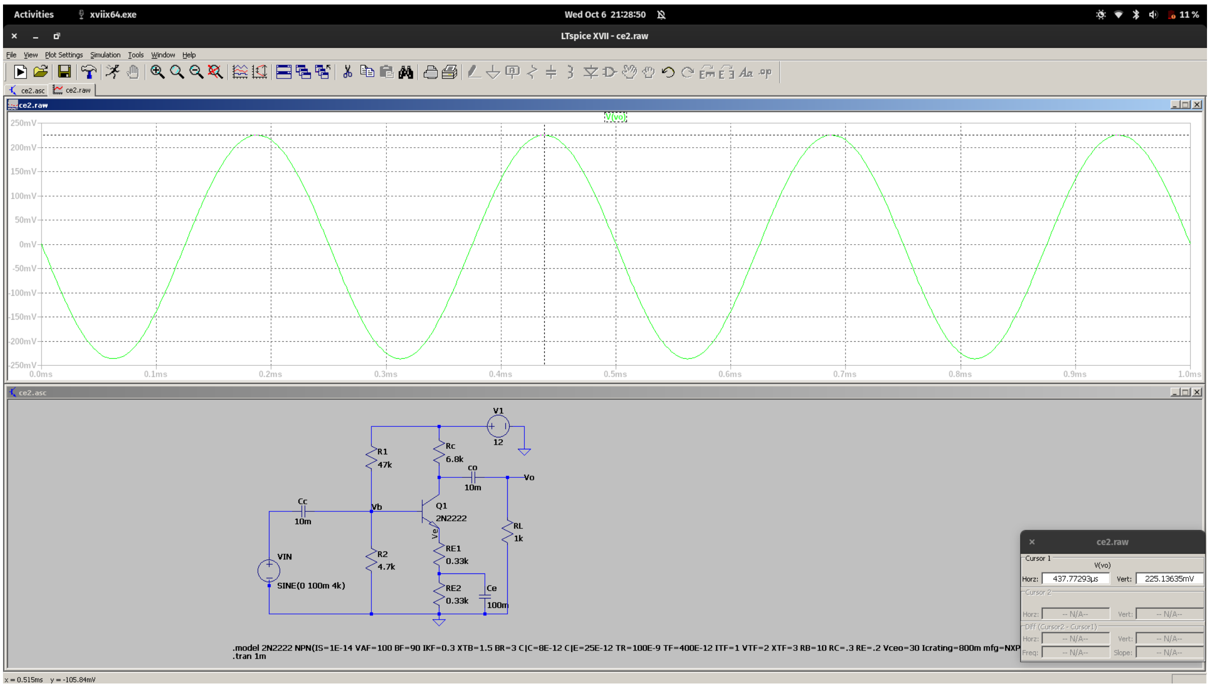
Vo = 4.368V

Gain A = Vo/Vi = 9.706

Vsm = 0.45V

2)With Load Resistance -

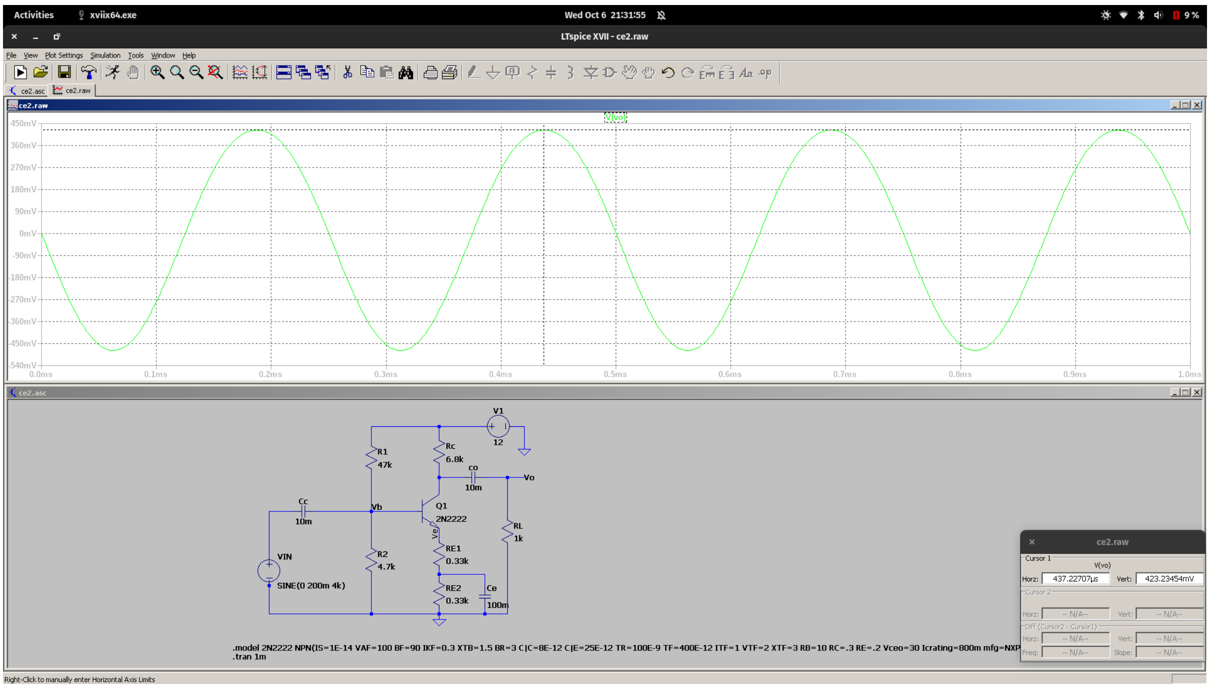
a)Vin = 0.1V



Vo = 225.136mV

Gain A = Vo/Vi = 2.251

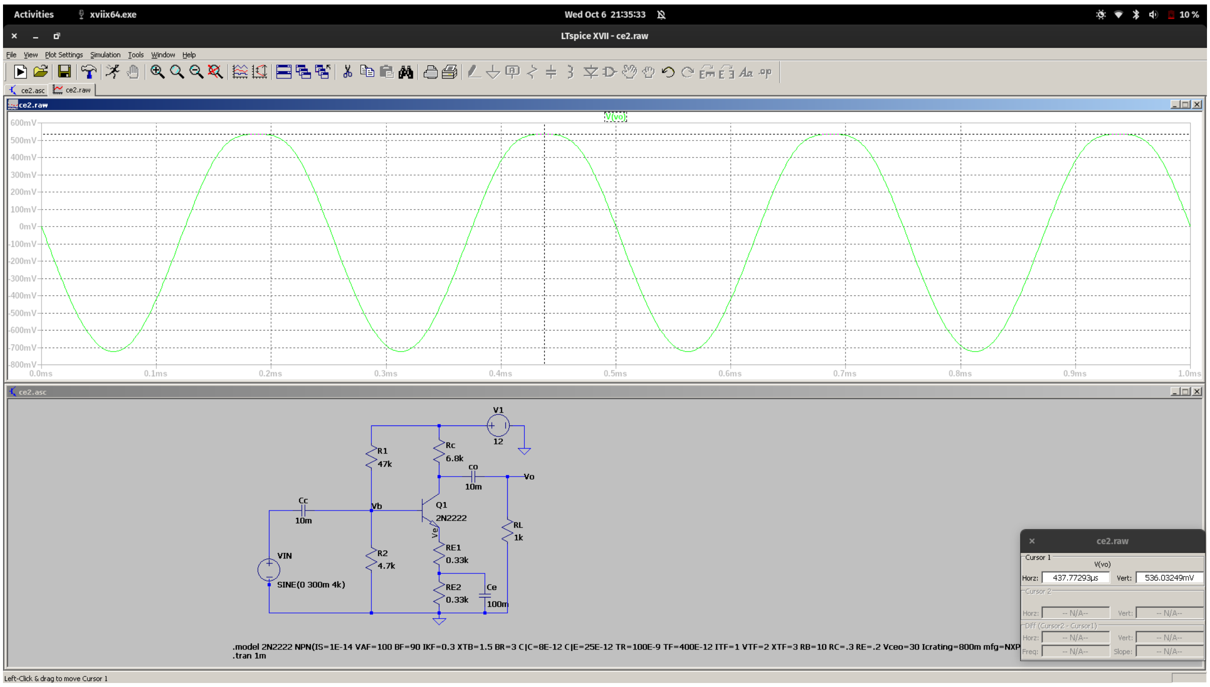
b)Vin = 0.2V



Vo = 423.234mV

Gain A = Vo/Vi = 2.116

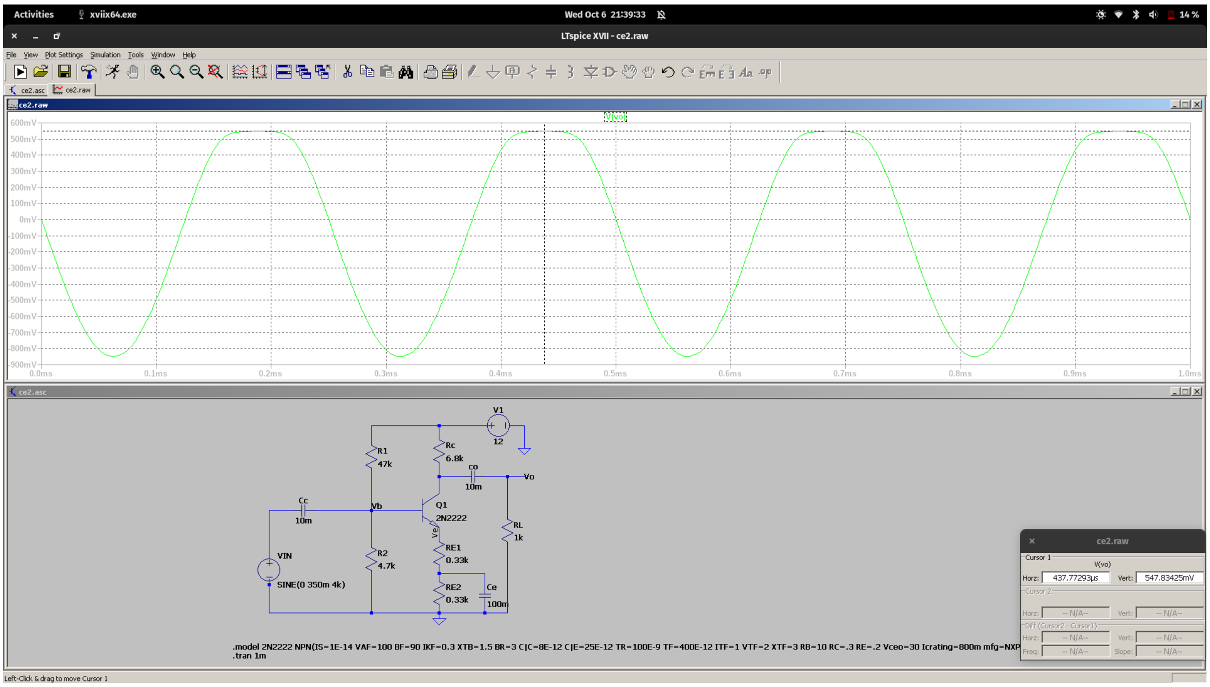
c)Vin = 0.3V



Vo = 536.032mV

Gain A = Vo/Vi = 1.786

d)Vin = 0.35V



Vo = 547.834mV

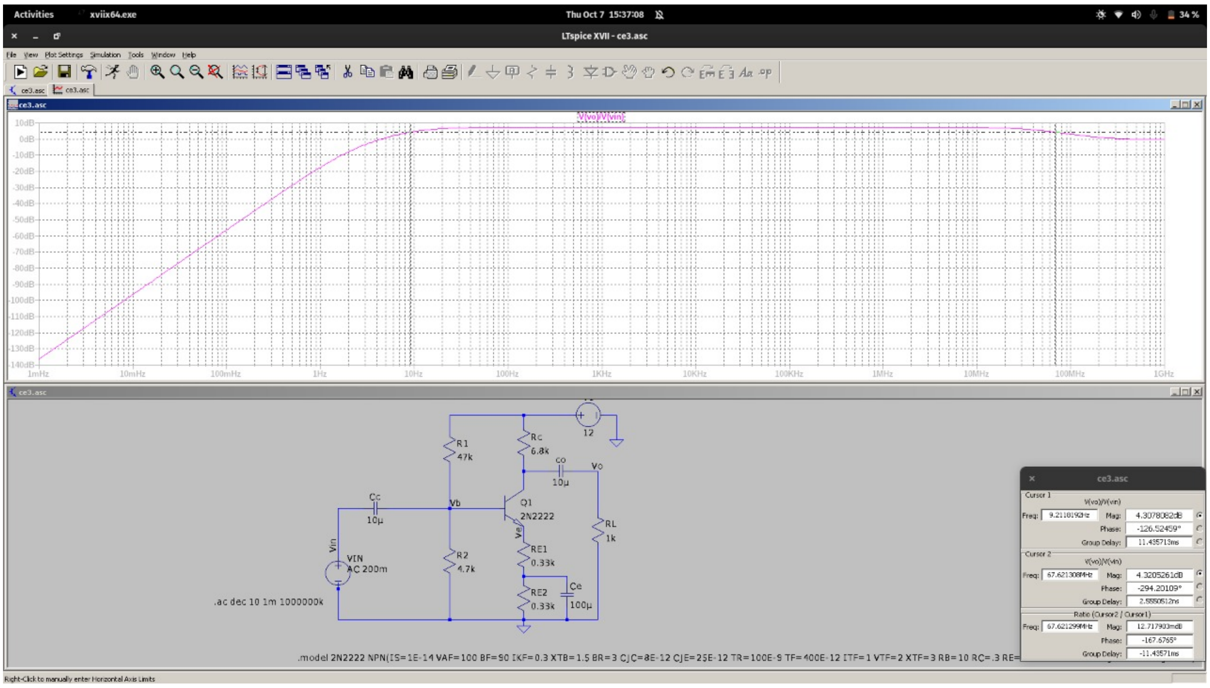
Gain A = Vo/Vi = 1.565

Vsm = 0.35V

Vsm without RL is 0.45V and with RL is 0.35V. (CLose by)

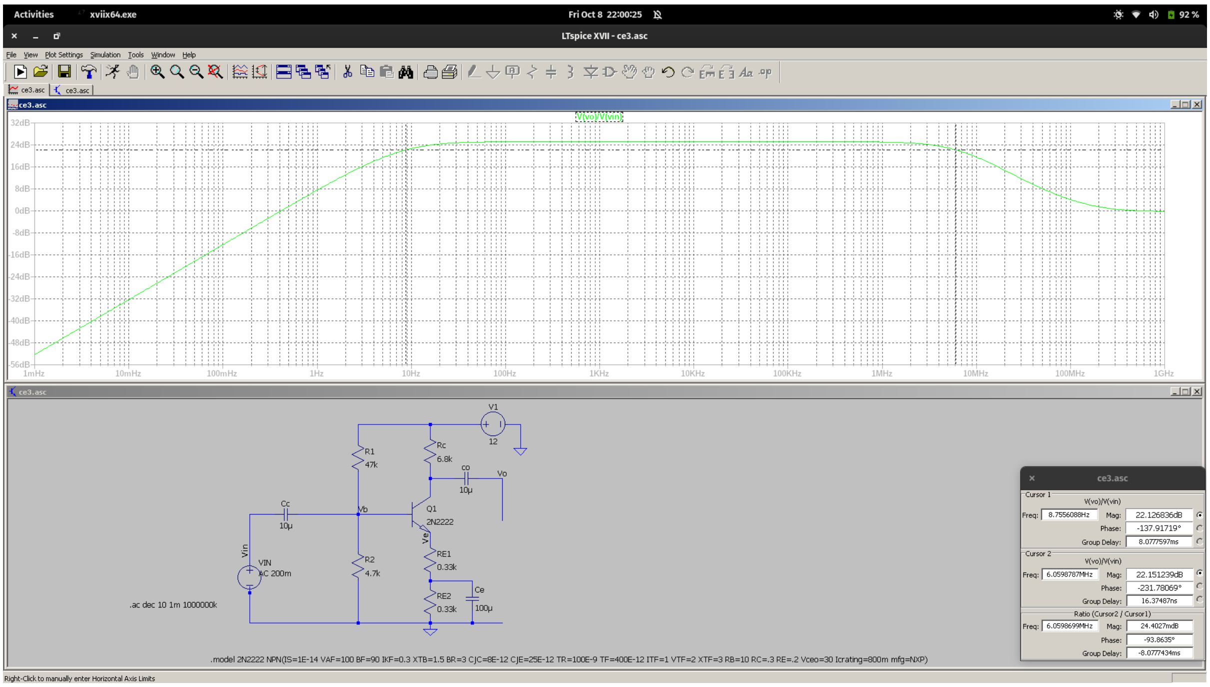
Measurement of Frequency Response

(i)



Low Cutoff Frequency **= 9.211Hz**
High Cutoff Frequency **= 67.621MHz**

(ii) Load Disconnected

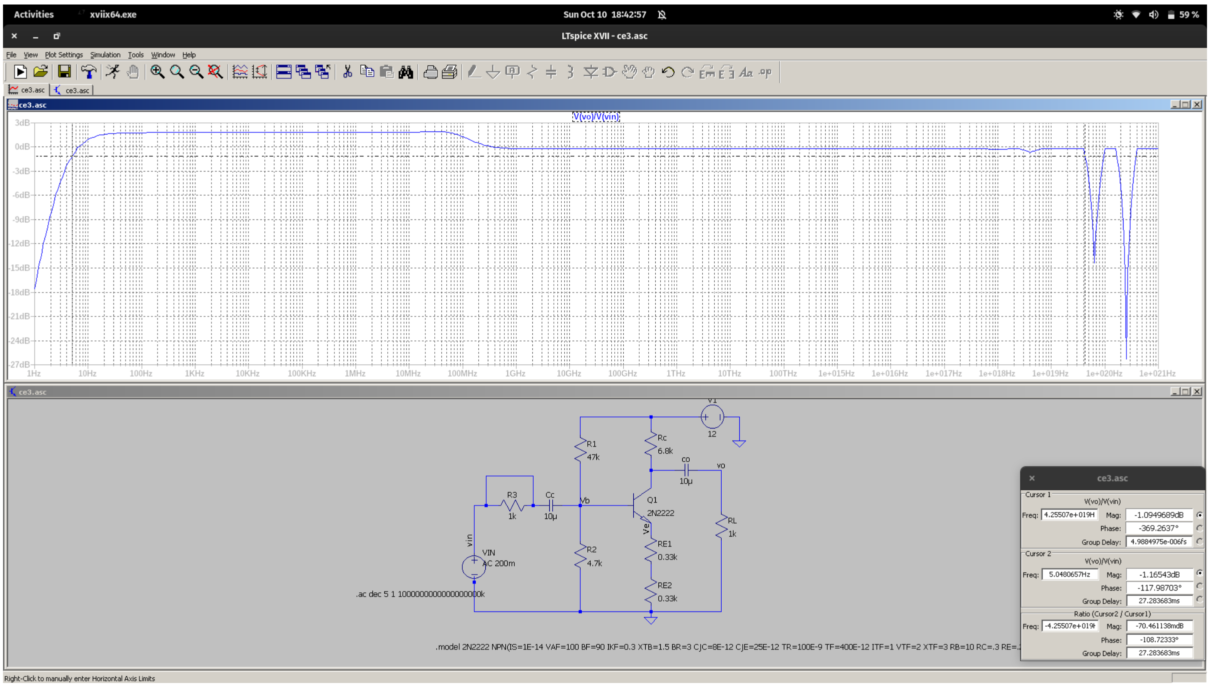


Low Cutoff Frequency **= 8.755Hz**

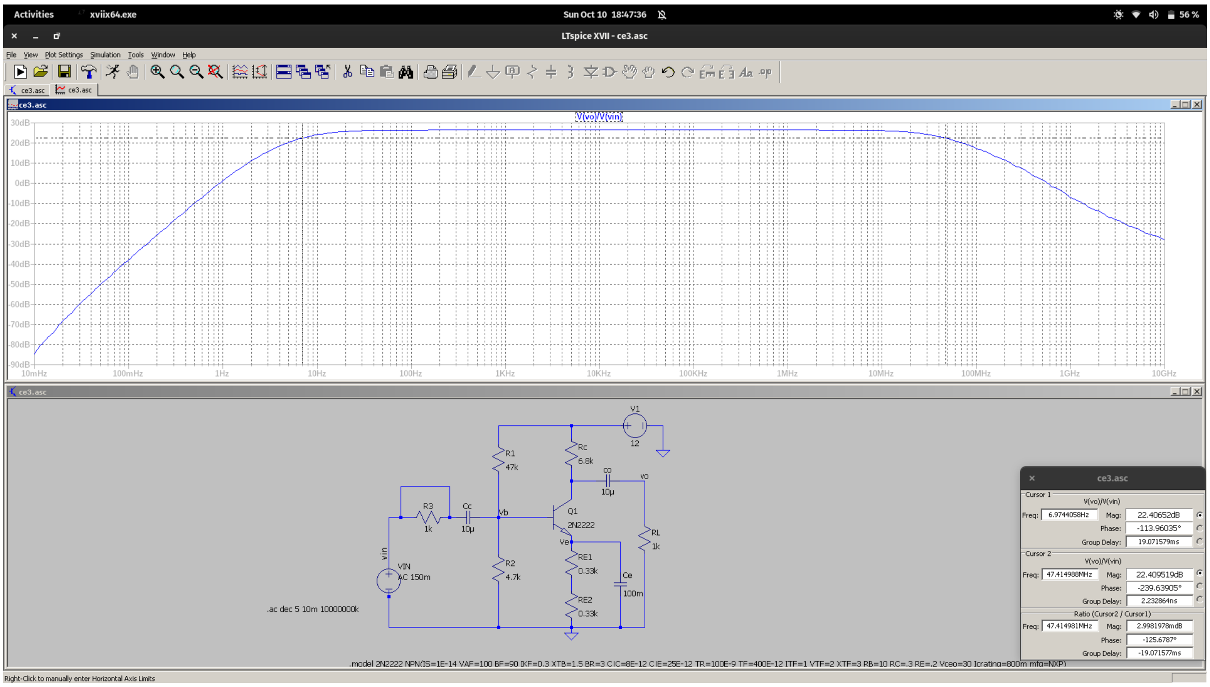
High Cutoff Frequency **= 6.059MHz**

From the above two(with and without load resistance), Low cutoff frequency is close by, but high cutoff frequency varies by 10x times.

(iii) Effect of Ce



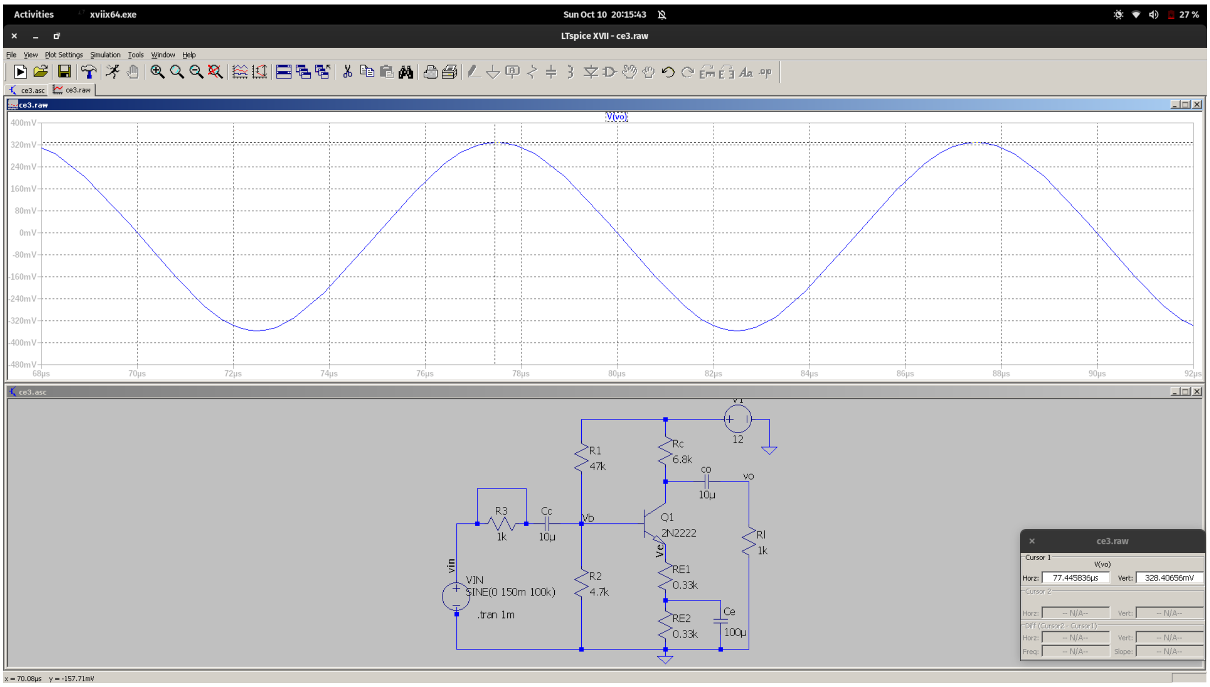
(iv)Re1 , Re2 fully biased



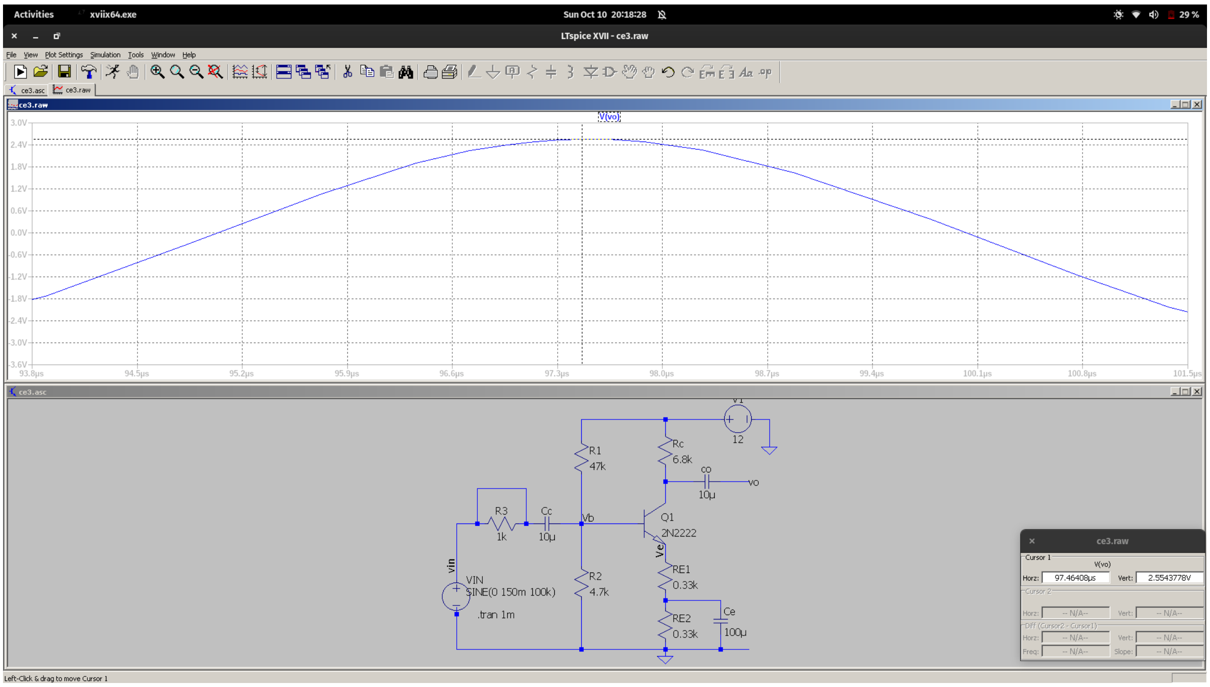
Low Cutoff Frequency **= 6.974Hz**
High Cutoff Frequency **= 47.414MHz**
Full Biasing of Ce leads high cutoff frequency to decrease drastically from 67.621MHz to 47.414MHz.

Output Resistance in the Mid-Frequency Range

RL = 1K ,Vin = 150mV, F = 100KHz



Vout | RL = 0.328V



Vout | R(infinity) = 2.554V

Measurement of output resistance in mid-frequency range:-

$V_{out}|R_L = 0.328V$

$f = 100\,kHz$, $R_L = 1k\Omega$

$V_{out}|R_\infty = 2.554V$

$V_{in} = 150\,mV < V_{SM}$

$$R_{out} = R_L\left(\frac{V_{out}|R_\infty - V_{out}|R_L}{V_{out}|R_L}\right)$$

$$= 1000\left(\frac{2.554 - 0.328}{0.328}\right)$$

$$\boxed{R_{out} = 6786.585\,\Omega}$$