STUDIES ON SMALL SIGNAL CE AMPLIFIER

Trace the circuit of the CE-amplifier given in Part-1 of the board (see bottom side). Note down the component values and match them against Fig.1.

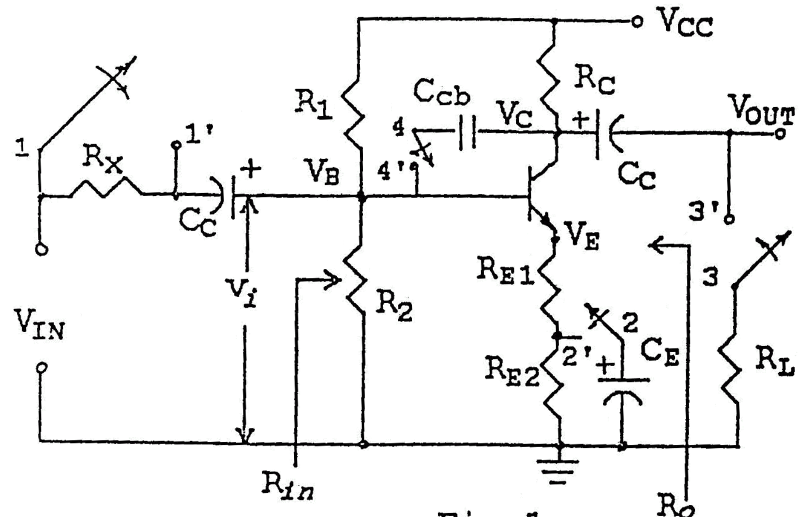


Fig.1

R_1=47K

R_2=4.7K

R_C=6.8K

R_{E1}=0.33K

R_{E2}=0.33K

R_X=1K

R_L=1K

C_C=10mFd

C_E=100mFd

C_{cb}=33pF

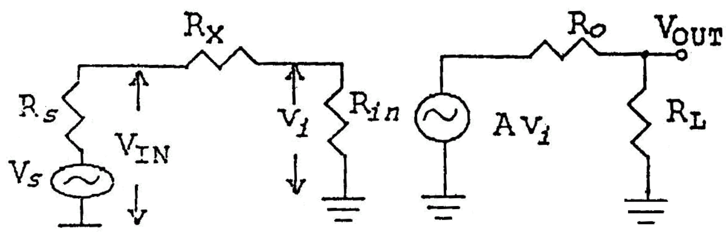


Fig.2

Measurement of DC conditions:

Supply +12 Volts V_{CC} to the amplifier circuit from the dc power supply. Remember to connect the power supply ground to the circuit ground! Measure V_B, V_C, and V_E. Remember these voltages are measured with respect to the circuit ground. Knowing these and the resistance values calculate V_{BE}, V_{CE}, I_C and I_E. Determine whether the amplifier is biased in the active region and whether the Q-point is suitably located.

Measurement of Signal Handling Capacity:

(i) Short the resistor R_X (by connecting a jumper wire across it; i.e. by joining the points 1 – 1' in Fig.1. Bypass R_{E2} by joining points 2 – 2' (thereby connecting C_E across R_{E2}). Apply a mid-band frequency (say 4 KHz) sinusoidal voltage of about 100 mV p-p amplitude at V_{IN} and observe the output waveform on the CRO. Measure the gain. Increase the input voltage in steps and measure the corresponding output voltages. Note the maximum input voltage V_{SM} for which the gain remains constant (or beyond which the V_{OUT} vs V_{IN} curve deviates from a straight line). This is the signal handling capacity. A quick (but crude) way of determining V_{SM} is to note the maximum input voltage for which the CRO displayed output voltage remains undistorted. Note when using CRO, it is convenient to measure the peak to peak voltage.

(ii) Now connect the load R_L by joining points 3 – 3'. Measure V_{SM}. Compare this result with that of (i).

<u>Measurement of Frequency Response:</u>

(i) Keep R_X shorted, load R_L and capacitor C_E connected. Choose a convenient sinusoidal V_{IN} (amplitude well below V_{SM}). Vary the frequency over the range of your signal generator (say 100 Hz – 1000 KHz) in convenient steps. Record the corresponding V_{OUT} at each step. It is convenient to choose a constant amplitude V_{IN}. This may be ensured by noting the peak-to-peak amplitude in the CRO at each frequency step. Increase the number of steps in regions where change in V_{OUT} is large. Plot the frequency response of the amplifier (i.e. plot $20\log(V_{OUT}/V_{IN})$ vs frequency). From the plot determine the lower and upper cutoff frequencies. These are the frequencies at which the ratio $20\log(V_{OUT}/V_{IN})$ falls 3-dB below its maximum value.

(ii) Now disconnect load R_L by removing the connection between the points 3-3'. Obtain the frequency response as in (i) above.

(iii) <u>Effect of</u> C_E: Keep 1 – 1', 3 – 3' connected. Remove the connection between 2 – 2'. Measure the frequency response. Compare with (i) above. Finally, consider the case when point 2' is instead connected to the emitter (i.e. R_{E1} & R_{E2} are fully bypassed) and measure the frequency response. Compare this response with those above.

(iv) <u>Miller effect due to</u> C_{cb}: Disconnect 1 – 1'. Connect 2 – 2' and 3 – 3'. Now measure the frequency response when
 (a) terminals 4 – 4' are connected,
 (b) terminals 4 – 4' are disconnected.
 Compare the results of (a) and (b) above.

<u>Measurement of Input Resistance in the Mid-Frequency Range:</u>

Connect 1 – 1', 2 – 2' and disconnect 3 – 3', 4 – 4'. For a V_{IN} having amplitude well below the signal capacity V_{SM} and frequency well within the midfrequency range, measure the output voltage $V_{OUT}|_{O}$. [From Fig.2: $V_{OUT}|_{O} = A \cdot V_S \cdot R_{IN} / (R_{IN} + R_S)$]. Now disconnect 1 – 1' and measure the output voltage $V_{OUT}|_{Rx}$. [From Fig.2: $V_{OUT}|_{Rx} = A \cdot V_S \cdot R_{IN} / (R_{IN} + R_S + R_X)$].

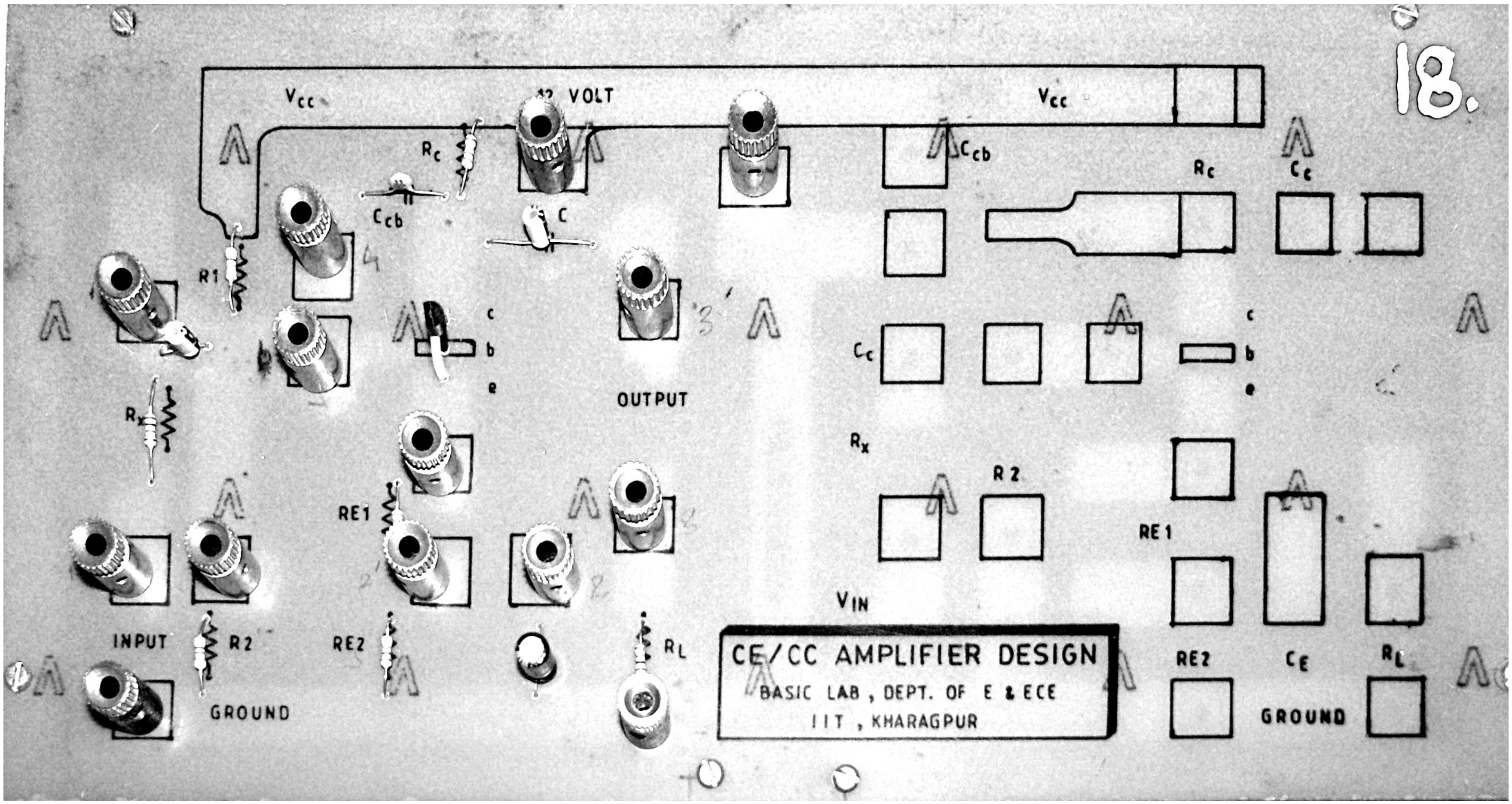
Then the input resistance is given by: $R_{IN} = \dfrac{Rx \cdot Vout|_{Rx}}{Vout|_{O} - Vout|_{Rx}} - R_S$

<u>Measurement of Output Resistance in the Mid-Frequency Range.</u>

Connect 1 – 1', 2 – 2', 3 – 3' and disconnect 4 – 4'. Then for a V_{IN} well below the signal handling capacity V_{SM} and frequency well within the midfrequency range let the measured output voltage be $V_{OUT}|_{RL}$. [From Fig.2: $V_{OUT}|_{RL} = A \cdot V_{IN} \cdot R_L / (R_O + R_S)$].

Now disconnect 3 – 3'. Then the measured output voltage is $V_{OUT}|_{\infty}$. [From Fig.2: $V_{OUT}|_{\infty} = A \cdot V_{IN}$]. Then the output resistance is given by

$$R_{OUT} = R_L \cdot \frac{V_{OUT}|_{\infty} - V_{OUT}|_{RL}}{V_{OUT}|_{RL}}$$


18.
Vcc
VOLT
Vcc
Rc
Ccb
C
R1
c
b
e
OUTPUT
Rx
RE1
INPUT
R2
RE2
RL
GROUND
VIN
CE/CC AMPLIFIER DESIGN
BASIC LAB, DEPT. OF E & ECE
IIT, KHARAGPUR
Cc
R 2
RE1
RE2
CE
GROUND