Experiment No.(1)

Multistage amplifiers

Object: To illustrate what happens when transistor amplifiers are connected in cascade.

Apparatus:

1- Oscilloscope (double beam)

2- Function generator (wide range)

3- D.C power supply

4- Two transistors of type (2N2222)

5- Many Capacitors, resistors and breadboard

Theory:

Often it is impossible to achieve all the required gain from a single stage amplifier. For example, an output voltage of 10volt is required and an input voltage of only 1mV is available, then an amplifier with a voltage gain Of 10000 would be required. This is normally too high gain to be obtained from a single stage, therefore more than one stage is needed. .

Consider an amplifier (stage A) with gain A_1 is connected to amplifier (stage B), with gain A_2, as shown in Fig.(1) . Suppose an input signal of (v_{in}) units applied to stage A, the output of stage A will be $A_1 \times v_{in}$ units. Thus $A_1 v_{in}$ units are applied to stage B giving an output from B of $\mathbf{A_2 \times A_1 \times v_{in}}$ units. Thus, the total gain of the two stages connected in series is give by:

$$\mathbf{A_{total} = A_1 \times A_2}$$

Therefore, to gate a gain of 10000, two stages with gain of 100 each is used. The next task now is how to connect the two stages (in cascade) together. Assuming two common emitter amplifiers connected in cascade, and then the collector of the first stage connected to the base of the second stage through a coupling capacitor. The advantage of this capacitor is to block the d.c voltage of the first stage to effect the biasing of the next stage. With the use of coupling capacitor, the design of the two stages carried out separately.

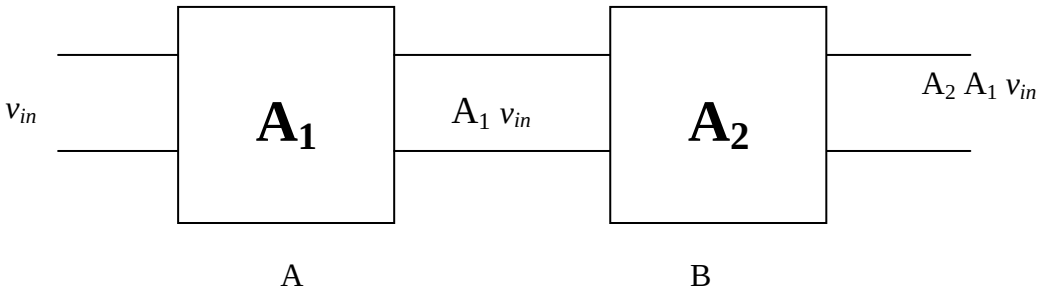

Fig.(1) Cascade Amplifier

Frequency Characteristics

To investigate the frequency response of cascade amplifier, note that each amplifier has an upper cutoff frequency of f_1. The amplification of each stage at cutoff frequency is 0.707 times of the maxim amplification. For two stages amplifier, the cutoff frequency becomes 0.707×0.707 of the maximum amplification. Thus, the upper cutoff frequency will be less than that of each stage. This is shown in Fig.(2).

Thus, the bandwidth of the cascade amplifier is decreased. The decreases of BW is proportional with No. of stages.

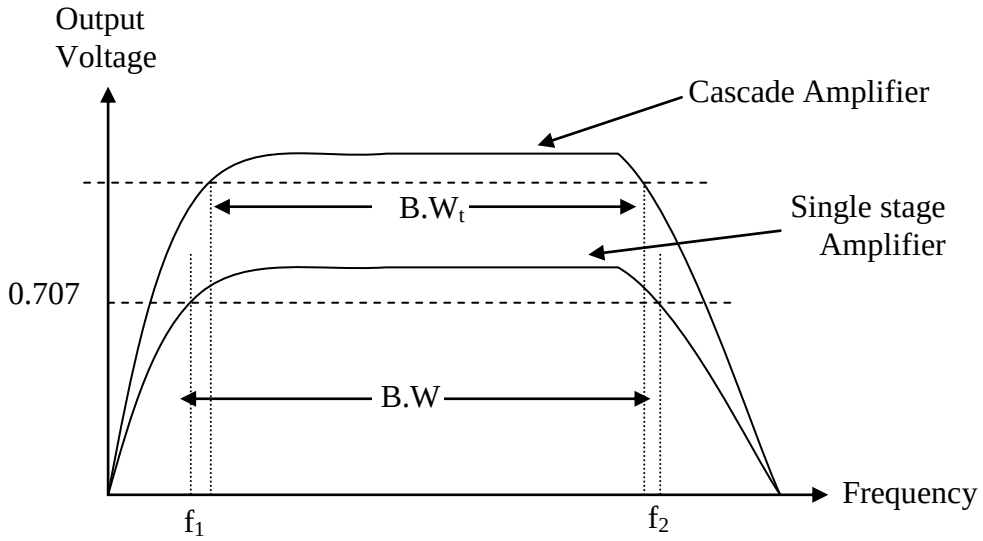

Fig.(2) The frequency response

Procedure:

Part (A)

Consider the circuit shown in Fig. (3), it is a single stage amplifier

1- Connect the circuit.

2- Give an input to the amplifier so that the output is 4Vpp at 1 kHz Measure the input voltage (f=1 kHz).

3- Give an input of 0.5V p-p to the amplifier. Vary the frequency from 50 Hz to 500 kHz in steps and record the output voltage.

Par t (B)

Consider the circuit shown in Fig. (4), it is a two stage amplifier (RC coupled amplifier).

1- Connect the circuit.

2- Give an input to the amplifier so that the output is 4 Vp-p at f=1kHz also measure the output voltage of the first stage.

3- Give an input of 0.5 Vp-p to the first amplifier. Then vary the frequency from 50 Hz to 500 kHz and record the output voltage.

Calculation and graphs

Part (A)

1- Find the gain (A) of the single stage amplifier at 1kHz

2- Find the gain amplifier at each step of frequency.

3- Plot the frequency response of the amplifier.

Part. (B)

1- a. Find the gain of cascade amplifier at 1 kHz.

b. Find the gain of each amplifier.

2- Plot the frequency response of the cascade amplifier.

Discussion:

1- Is the overall gain equal to or less than the product of the gains of the individual amplifier? Why?

2- What is the use of RC coupled amplifier? Give some application.

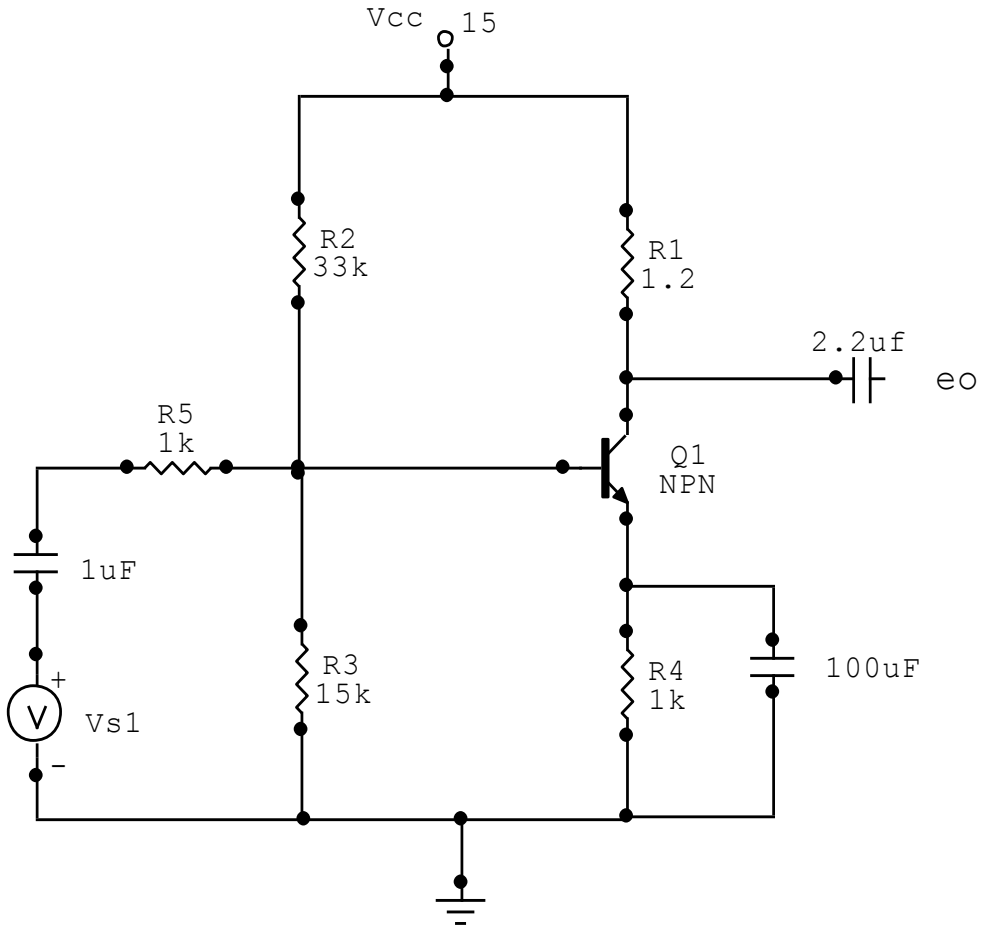

Fig.(3) Single stage amplifier

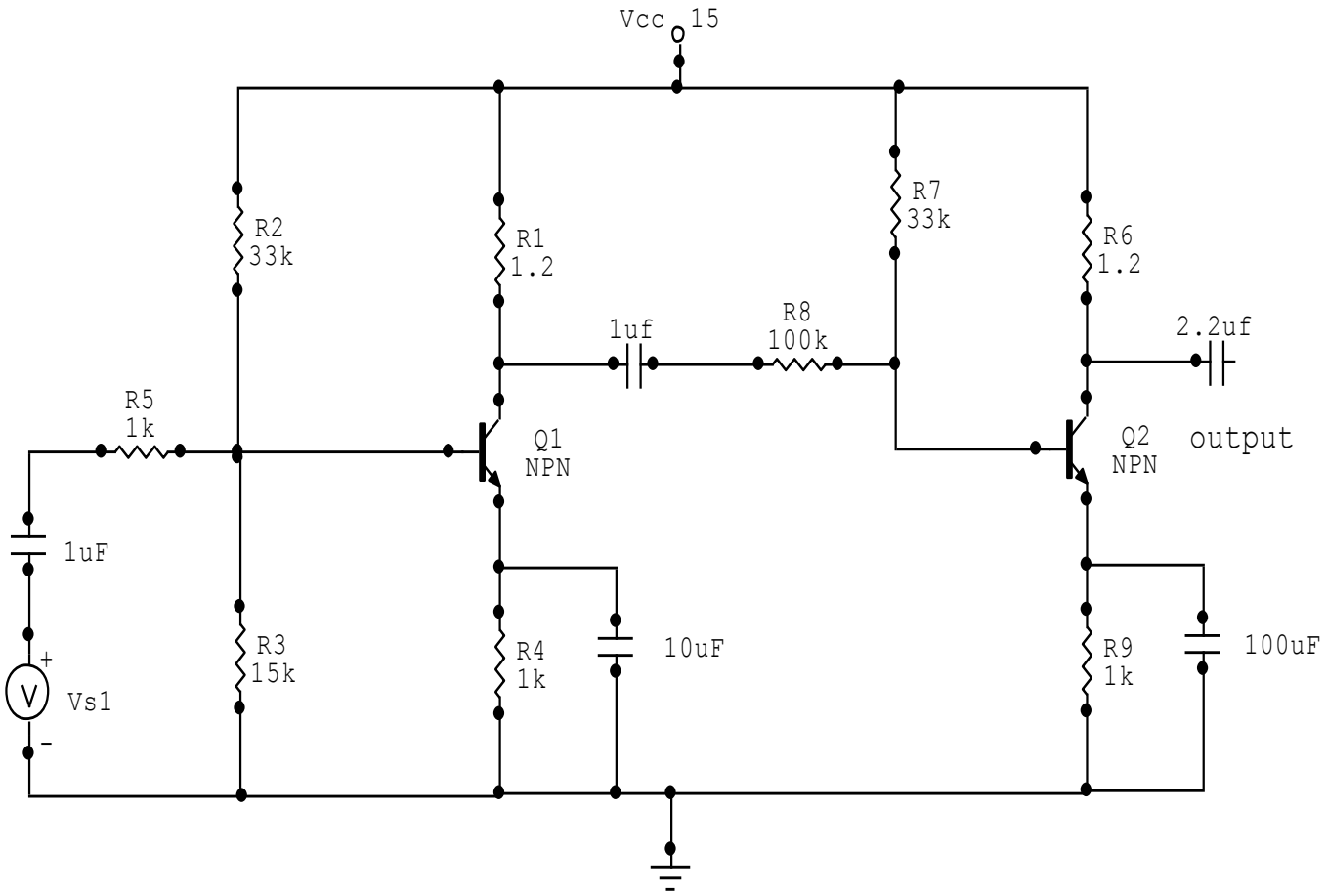

Fig.(4) RC Coupled Amplifier